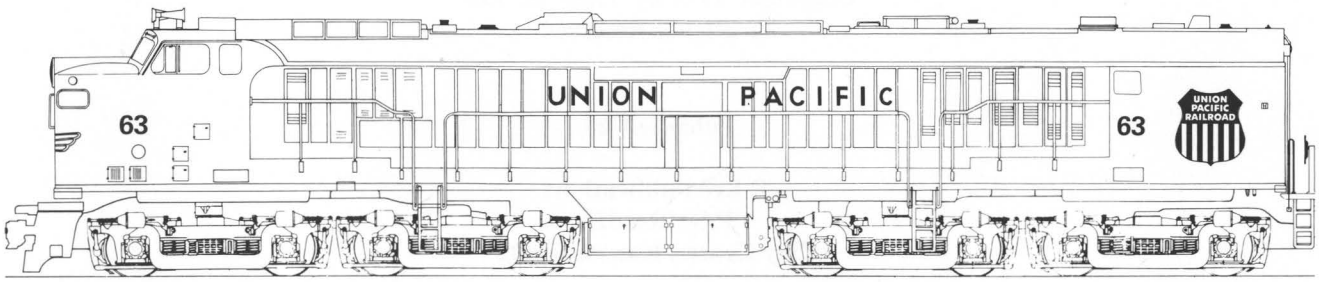
TURBINES WESTWARD

THOS. R. LEE

With the beauty of the Wasatch Range at its back, Union Pacific gas turbine electric #23 is pulling out of Riverdale Yard at Ogden, Utah, in August 1969 with an eastbound manifest. This distinctive painting by the noted industrial designer artist, Chester J. Mack, truly depicts the purpose for the turbine locomotive — the continual battle of machine against mountain, the search for the ultimate in motive power design.

TURBINES WESTWARD



THOS. R. LEE

Dedicated to

my sons

Michael and Richard

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Foreword

For almost twenty years the Union Pacific Railroad operated a fleet of gas turbine electric locomotives in their motive power stable to help move the heavy density of freight traffic that the historic railroad enjoys. **TURBINES WESTWARD** is the story of that unique chapter in railroad history, for the Union Pacific was the only railroad to own such power. A total of fifty-nine turbine locomotives saw service on the Union Pacific, and all are pictured herein as both the railroad and railfan saw them.

The author is deeply indebted to the following people for their gracious help in supplying both photographs and material for this publication.

To my good friend, Richard H. Kindig, a leading name in rail photography and Union Pacific history, a special thank you for the use of his many fine photographs. Although a champion of the steam age, Mr. Kindig was none the less a turbine fan, and his cooperation is much appreciated.

To William W. Kratville, railfan and author of many fine books covering the Union Pacific, my sincere gratitude, both for his material so generously shared and his support and encouragement in this writing.

A special acknowledgement of thanks is due Edwin C. Schafer, Barry B. Combs, John Witherbee, C. R. Rockwell, John H. Forbes, and Allan Krieg of the Union Pacific Public Relations Department for their assistance in furnishing both photographs and material, much of it historic. Sincere appreciation is also extended to Richard E. Prince, R. E. Marquart, and Leonard F. Zeiler of the Motive Power and Machinery Department for their diligent help. Mr. Prince gave generously of his time on this project, and his aid was invaluable in many ways. As usual the fine cooperation and support by Union Pacific officials and employees is unsurpassed.

Thanks also go to J. A. Rutherglen of General Electric for the sharing of his experience on the experimental steam turbine and gas turbine locomotives, and for the use of his extensive photographic collection.

Many other members of the railfan fraternity helped preserve turbine history on film and to Wallace W. Abbey, Emil Albrecht, Steven W. Belmont, George R. Cockle, Donald Duke, James L. Ehernberger, William A. Gibson, Gordon Glattenberg, Henry R. Griffiths, Byron E. Guise, Lewis Harris, Steve Harris, Robert H. Heuerman, Thomas M. Hotchkiss, Stan Kistler, Paul R. McDonald, J. L. Ozment, D. J. Rands, Lou Schmitz, Richard Steinheimer, Art Stensvad, Chard Walker, Jim Watson, and A. J. Wolff my sincere thanks for their contributions of excellent photographs.

The distinctive cover and frontispiece painting was created by Chester J. Mack, the noted industrial designer/artist, and was made available through the courtesy of Mr. Mack and Utah Pacific of Salt Lake City. Mr. Mack was the creator of the locomotive paint design for the original American Freedom Train which toured the country from 1947 to 1949. More recently, his design achievements include the color scheme and Liberty Bell motif for the Southern Pacific and Cotton Belt Railroad diesel locomotives that are participating in this nation's Bicentennial celebration.

I also want to thank Jim Woodward of the Pine Bluffs Post, Dan and Don Dover, David P. Morgan, Ralph L. Gochnour, Homer E. Socolofsky, Anna Marley, David R. von Riesen, Lewis M. Phelps of the Norfolk and Western Railway, Franklin J. Carr of the Chesapeake and Ohio Railway, and the Everett L. DeGolyer Library for their contributions toward the final creation of this work.

Finally, to Dean Coughenour and his fine staff at Ag Press, my appreciation for their cooperation in the publication of this book.

TURBINES WESTWARD is probably not the complete story of the turbine locomotive. Many additional photographs and facts of operation will continue to surface for use in other publications, notably in George Cockle's forthcoming U.P. motive power books, and in Extra 2200 South, the Locomotive Newsmagazine; but, for the moment, the author hopes that these few pages will help relive the memories of the Union Pacific turbine era.

Manhattan, Kansas *Thos. R. Lee*
April 1976

Union Pacific Railroad

The erstwhile steam turbine electrics resembled early Steamliners except in performance and were the first such locomotives in the U.S. Numbered 1 and 2, the units are on Lane Cut-off outside of Omaha with a westbound 15 car test train, April 5, 1939, for this publicity photo.

Union Pacific Railroad

A power mixture of ancient 4-4-0 #58, steam turbine electric #1, Electro-Motive E-3 diesel LA-5, and 4-6-6-4 "Challenger" steamer #3939, pose at the Los Angeles Union Station on April 22, 1939.

TURBINES WESTWARD

The West is big country, spanned by large railroad systems handling big trains. To the operations department, the name of the game is horsepower — the ability to move heavy tonnage at fast speed. For the Union Pacific, these demands have meant the continual search for the biggest and best in motive power development.

During the steam era the Union Pacific developed the unique three cylinder 9000 class 4-12-2 steam locomotive, was the first road to use the large 4-6-6-4 simple-articulated "Challenger" steamers, and was the only railroad to own the world's largest steam locomotive, the incomparable 4000 class 4-8-8-4 "Big Boys."

Added to this, however, is one of the most unusual but significant chapters in the history of locomotive power, for the Union Pacific also received the first American steam turbine electric locomotive and was the only U. S. railroad to own a fleet of gas turbine electric locomotives.

In December 1938, General Electric outshopped America's first steam turbine electric locomotive, two identical 2500 horsepower passenger units, for Union Pacific in an expensive effort to match Electro-Motive's new diesels. Nearly two years had been spent by GE and U.P. engineers in designing and building the new type locomotive. This two unit experiment was lauded as the "replacement to steam", the "successor of diesels."

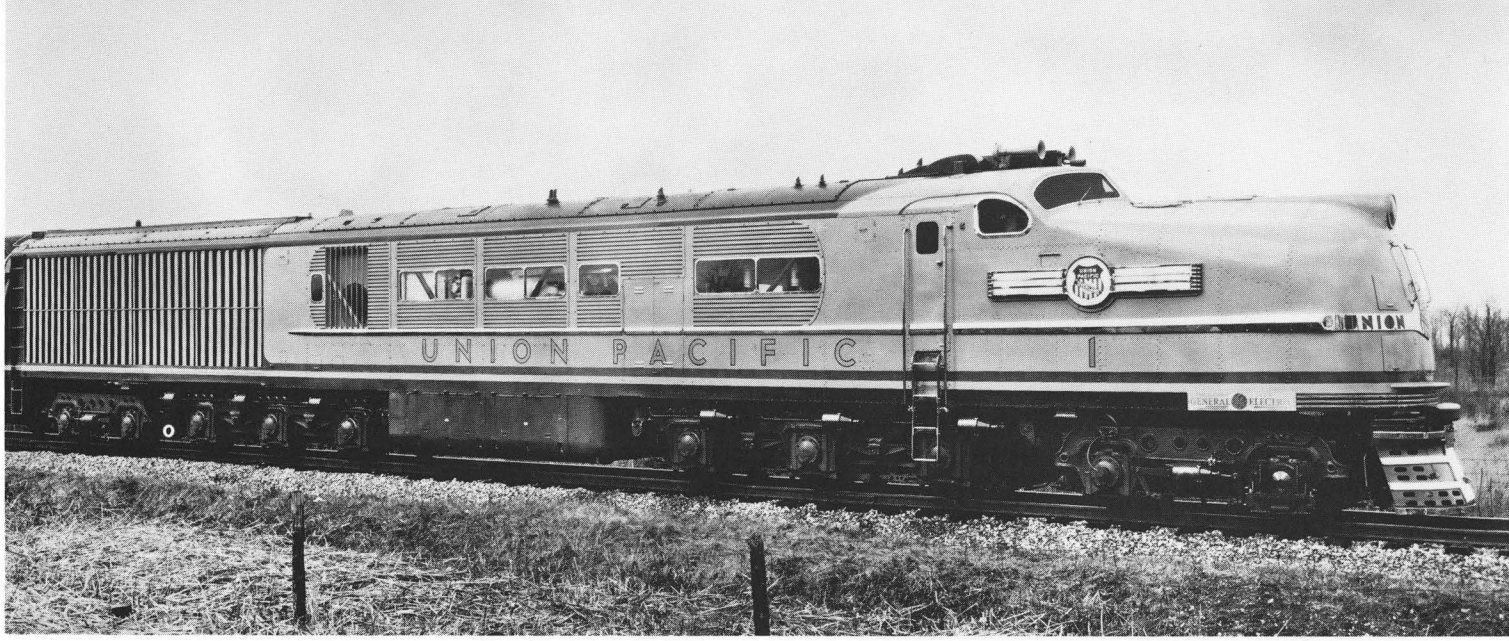
Styled like the first "City of Denver" diesels, the external appearance of the units was quite unlike the usual steam locomotive. After steam had been generated up to 1,500 pounds pressure in an oil-fired, water-tube boiler, it was directed against a two-stage, cross-compound turbine which was geared to two direct-current generators. The generators supplied power to the six electric traction motors which were hung on the locomotive driver axles.

The most unusual feature of the locomotive was a large air-cooled condensing system which enabled the unit to perform the seemingly impossible task of running 500 miles or more between water stops. Being a closed system, in which the boiler literally reboiled distilled water condensed from previously used steam, the replenishment quantity was minimal. Although the system contained nearly 3,000 pounds of water, the forced circulation cycle within the boiler was completed in less than three and one-half minutes.

Upon completion, the locomotives, numbered 1 and 2, were first given a stationary test in which the traction generators were connected to a water box load. In this way the complete power plant could be tested under conditions similar to those in actual service except for the motion of the units over the track.

After considerable checking and some minor modifications, the locomotives were given track tests, with speeds up to 75 miles per hour, on the General Electric test track at Erie, Pennsylvania, with both single and multi-unit operation of the two units. Loaded coal cars were used to simulate the trains to be hauled.

Union Pacific Railroad



Union Pacific Railroad

America's first steam turbine electric locomotives had a 2-C-C-2 wheel arrangement with wheel base of 78' 8", driver diameter of 44", and idler wheel diameter of 36". Each unit had a total weight of 548,000 lbs. fully loaded, 346,000 lbs. on drivers, giving a starting tractive effort of 86,500 lbs. Total length of the unit was 90' 10". They were the first steam powered locomotives to be equipped with dynamic electric braking.

Number 1 was then operated in a test on the New York Central main line between Erie, Pennsylvania, and Dunkirk, New York, hauling empty passenger cars. Finally, in late January 1939, the double unit locomotive, in beautiful Union Pacific colors, chrome trim, and heralds, was put in test operation with regular passenger trains on the New York Central between Buffalo, New York, and Cleveland, Ohio, for a period of ten days.

After final modifications, the two units were delivered to the Union Pacific under their own power, leaving Chicago over the Chicago & North Western Railroad on April 3, 1939, with a U.P. baggage car and coach. In the early hours of April 4, numbers 1 and 2, were on Union Pacific rails for the first time. They spent the day in the Omaha shops for a general inspection before hauling a non-revenue 15 car passenger train to Cheyenne, Wyoming, on April 5. On April 6 and 7, the units made several round trips over Sherman Hill to Laramie with the test train, before departing with train #717, the "Los Angeles Challenger", for Salt Lake City. On the 8th, they took #5, the "Fast Mail", to Los Angeles.

On April 24, the steam turbines left Los Angeles with a special train headed by #58, an ancient 4-4-0 steamer, for Omaha and the premiere of Cecil B. DeMille's movie, "Union Pacific." On the 28th they took part in the Golden Spike Days ceremonies in Omaha, by being on display. From April 29 to May 15, both units were on exhibition in numerious eastern cities with the special train, traveling through Chicago, Detroit, Cleveland, and Boston enroute to New York City and Washington, D.C. before returning westward via Pittsburgh, Dayton, Cincinnati, St. Louis, and Kansas City.

On May 16 the turbines returned to U.P. rails and again entered the Omaha shops for a general inspection before conducting further tests. On May 19, number 1 took train #15 to Denver, returning the following day on train #12. On May 25, number 2 handled #15 to Denver, but on the return trip with #12 the unit had to be replaced at Sterling, Colorado, because of a boiler malfunction. On June 4 both units took train #15 as far as Grand Island, to test repairs on number 2, before returning to Omaha.

On the evening of June 5, the two steam turbines left Omaha with the 19 car Paramount Movie Special, arriving in Los Angeles the 7th, two hours and twenty-five minutes behind schedule. The next day they left for Ogden, Utah, and on the 9th handled an 18 car cherry train eastbound. At Grand Island the units were tied up behind a derailment and later came into Omaha light.

Predicted performance of the steam turbines was terrific. The 5,000 horsepower combination was designed to haul the "Los Angeles Challenger" with 12 standard passenger cars over the heavy 2.2% grades without helper assistance, then run 110 miles per hour on the straight and level. It was also designed so that either unit could be operated separately to haul a lightweight 500 ton train on the "City of Denver" schedule, approximately 1,000 miles in 16 hours.

The steam turbine electric locomotive was unusual in many respects, and the new type power was advertised as offering several operating advantages. With the

use of 1,500 pound, 920 degree Fahrenheit steam, the thermal efficiency from the fuel was more than double that of the conventional steam locomotive. The elimination of both corrosion and boiler scale was made possible by the use of distilled water in a closed system. Increased availability was believed possible because of the construction of the boiler, a type not previously used for railroad service. A fast rate of acceleration and braking, due to high adhesive weight, was important for passenger service. The use of electric braking would result in savings to both brake shoes and tires, while trackage would benefit through the elimination of unbalanced reciprocating parts which cause destructive forces to the rails, roadbed, and supporting structures. Finally, the locomotive was believed capable of 500 to 700 miles of operation without stops for fuel or water.

In actual road service, however, the experiment amounted to something considerably less than expectations. The high pressure steam boilers, condensers, and complicated gadgetry soon made it a white elephant for long distance operation. Although modified and refined, the units were difficult to keep tuned in proper operating condition. In addition the condensers sometimes failed to provide the proper water replenishment. What appeared good in scientific theory had failed to perform on the rails.

The units never entered regular pool service on the Union Pacific, and on June 17, 1939, their tests a failure, the steam turbines left Council Bluffs with a 21 car eastbound cherry train. They later arrived at the General Electric plant at Erie, Pennsylvania, never to return to the Union Pacific.

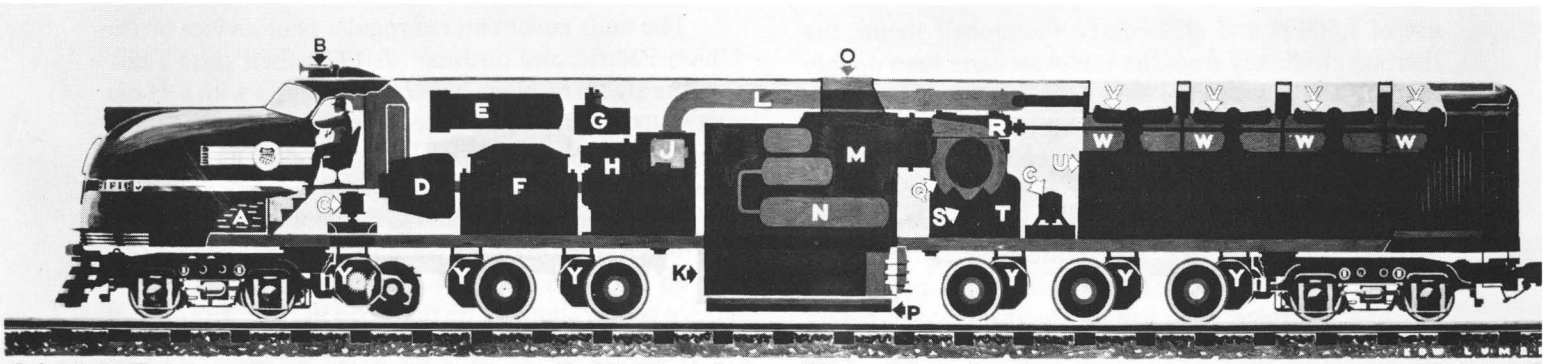
Renumbered GE-1 and GE-2 and repainted a dull gray-black, the two units were to see considerable service on the Great Northern Railway during a wartime motive power shortage on that road in 1943. In contrast to their performance on the U.P., the two units operated relatively trouble free on the short distance freight assignments they ran on the Great Northern. They were generally used between Wenatchee and Spokane, Washington, with an occasional trip east of Spokane. The two units ran back to back on the G.N. rather than nose to back as originally intended and previously used.

By late 1943, the wheel treads of both units were well worn and in need of replacement. At the same time the boiler of one unit became defective, so nearly a year of service on the Great Northern thus came to an end.

When returned to General Electric, the locomotives were retired, and the traction motors and generators were installed as the test stand drives at the Erie, Pennsylvania plant. They served in that capacity for many years.

J. A. Rutherglen Collection

Although built from the same design, steam turbine electrics 1 and 2 had minor carbody differences. Number 2 had small windows on both sides of the traction motor blower intake grille, while number 1 possessed only a single window to the rear of the intake. The vented access doors above the "PA" in the railroad name on the side also presented a point of difference, as the panels on number two were fitted with small windows while number one had none. The horns on number 1 were originally painted yellow, but before delivery to the U.P. they were repainted to conform to the paint scheme of number 2. At night the steam turbines exhibited an added touch of show as the beautiful multicolored heralds on the sides were brightly illuminated.



UNION PACIFIC STEAM-ELECTRIC LOCOMOTIVE
BUILT BY GENERAL ELECTRIC COMPANY

A RAW WATER TANK
B VERTICAL HEADLIGHT BEAM
C TRACTION MOTOR BLOWERS
D AIR CONDITIONING ALTERNATOR
E TRAIN HEATING EVAPORATOR
F MAIN GENERATORS
G AIR BRAKE COMPRESSOR
H REDUCTION GEAR
J MAIN TURBINE
K MAIN CONTROL CONTACTORS
L EXHAUST HEADER
M BOILER
N FEED WATER HEATER
O STACK
P BRAKING RESISTORS
Q BOILER DRAFT FAN
R CONDENSER FAN TURBINE
S FEED WATER PUMP
T BOILER AUX. SET TURBINE
U FUEL TANKS
V CONDENSER FANS
W AIR COOLED CONDENSERS
Y TRACTION MOTORS

DESIGN AND CONSTRUCTION

The boiler was a compactly built closed-system, water-tube, forced-circulation type, using distilled water. It included a furnace, superheater, economizer, air preheater, and burners for Bunker "C" fuel oil.

Adaptation of this type of boiler to a locomotive, where swaying and jarring motions are present, dictated a special mounting system to minimize the shock and vibrations that could have caused cracks and ruptures.

The furnace had two vertical burners. After leaving the furnace, the gases passed through a screen section and up through the economizer, superheater, and air heater to the roof stacks.

The economizer was an integral part of the boiler and utilized waste heat for increasing the temperature of the boiler feed water.

A compact propane-fired auxiliary boiler was used to start the main boiler when it was cold and an outside supply of steam was not available. This small boiler supplied steam for heating the fuel oil and atomizing the oil at the burners when starting the main boiler. Propane gas ignited by spark plugs served to light the fuel oil.

The boiler was located in the center so it could use the extra space below the carbody platform between the trucks. The main turbine generator set was ahead of the boiler and the auxiliary set and condensers were to the rear. This arrangement was necessary to get proper weight distribution with a practical running gear. With the comparatively small size of the main turbine generator set, the air compressor and train heating evaporator were placed above it and arranged for easy removal when required for maintenance.

The main turbine-generator set was made up of three assemblies: a geared turbine, a main direct-current generator, and an auxiliary alternator exciter.

The turbine was a cross-compound machine with two pinions running on a common gear. The turbine rotors ran at 12,500 rpm and the gear at 1,200 rpm.

The geared turbine was connected through a flexible coupling to the main direct-current generator set, made up of two 12-pole, variable-voltage generators which possessed an integral fan between the two armatures as an aid in cooling the closely coupled pair.

The main generator was direct-coupled to a third unit which consisted of an alternator and an exciter. The alternator supplied 230-volt, 3-phase, 60-cycle, alternating-current power for use when electrical power was required for train air conditioning and for traction-motor blowers and other auxiliaries on the locomotive.

The exciter was used to excite the main-generator fields during traction and the traction-motor fields during electric braking.

Steam was extracted from the first stage of the high-pressure turbine to drive the auxiliary turbine and condenser-fan turbine. First stage extracting steam was also used to heat an evaporator and supply make-up and train-heating steam. When sufficient extraction steam was not available for these purposes, high-pressure steam was automatically supplied through the auxiliary set and evaporator control valves.

The condenser system was mounted on both sides of the rear end of the locomotive carbody, and consisted of finned-type vertical tubes. Ventilation for the condenser was provided by turbine-driven propeller-type fans drawing air through the sides of the locomotive and discharging it through openings in the roof.

The air taken into the engine room for ventilating the generators, traction motors, and small equipment, entered through louvers in the cab side and also through raised intakes in the roof.

The six traction motors on each unit were axle-hung, geared to the axles through single, solid, spur gears.

The gearing presented problems in adequate lubrication over the range of speeds and temperatures met in service. An extreme-pressure lubricant was used, with the teeth lubricated by oil jets at high speeds.

The body of the locomotive was designed to combine great strength with light weight. The frame was built up with high-tensile steel tubular members, while the side sheets, roof sheets, and bulkhead sheets were aluminum. The streamlined nose was steel welded throughout. Almost the entire roof was removable in sections for maintenance purposes.

The drive wheel trucks had integral cast-steel frames, with the carbody carried on two flat center plates and four spring loading pads at the inner ends of the truck frames. Each pilot and trailing truck was connected to the adjacent driving truck by a spring-cushioned radius bar which permitted the smaller trucks to take curves freely and without oscillation.

The tanks containing 4,000 gallons of raw water were in the locomotive nose. The fuel-oil tanks, totaling 3,000 gallons, were at the rear between the condensers.

The train engineers cab controls had only motoring, braking, and reversing handles. There were 21 steps of motoring and 20 steps of manual electric braking.

Automatic train control and cab-signal equipment with suitable inductors for operation over the Union Pacific was installed on both units.

The mechanical and electrical parts of the locomotive were manufactured in the Erie, Pennsylvania plant of General Electric. The boiler was supplied by the Barberton plant of the Babcock & Wilcox Company, and the boiler control devices were supplied by the Bailey Meter Company of Cleveland. The electric motors, generators, and controls were basically the same as used in the diesel locomotives of that period.

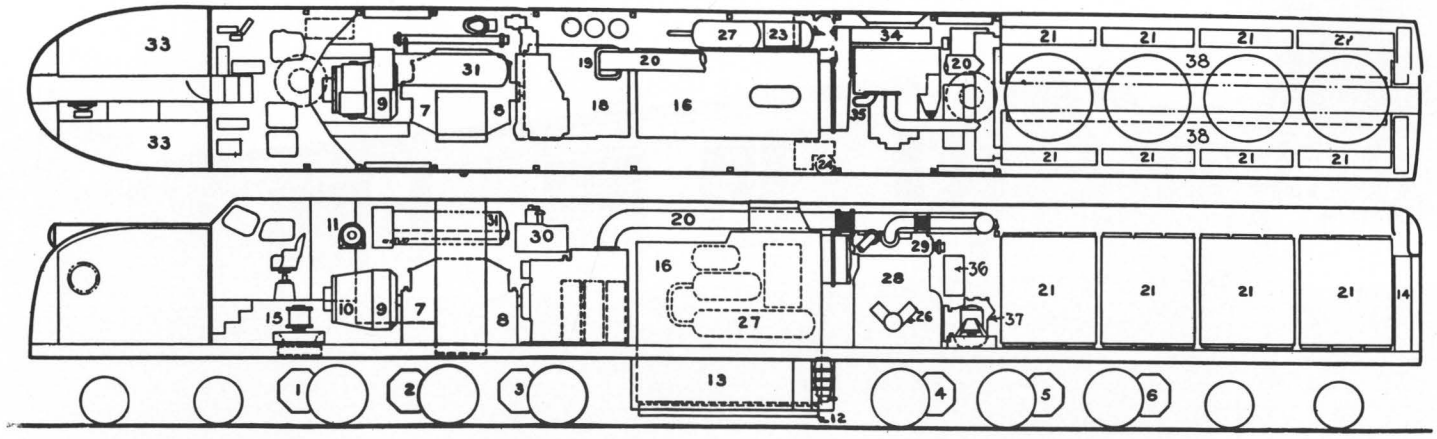


Diagram Showing Location of Apparatus in the Steam Turbine Electric Locomotive

1-6. Traction Motors
7-8. Main Generators
9. Alternators
10. Exciter
11. Battery Charging Set
12. Braking Resistor
13. Main Control Contactors
14. Battery
15. Traction Motor Blower
16. Boiler
18. High Pressure Main Turbine
19. Low Pressure Main Turbine
20. Exhaust Header
21. Air-cooled Condensers
23. High Level Condensate Tank
26. 1500-lb. Feed Water Pump
27. Feed Water Heater
28. Boiler Auxiliary Set Turbine
29. Condenser Fan Turbine
30. Compressor
31. Train Heating Evaporator
33. Raw Water Tank
34. Boiler Draft Fan
35. Braking Resistor Separator
36. Boiler Control Panel
37. Traction Motor Blowers
38. Fuel Oil Tanks

In 1946 a specific project to develop a gas turbine engine for railroad application was begun by General Electric. GE's research in gas turbine development actually had dated back to 1904. By 1948 GE and the American Locomotive Co. had turned their combined talents toward producing a revolutionary locomotive for America — the gas turbine electric. Experiments on such power had been progressing in Switzerland since 1941, when Brown-Boveri Co., Ltd. built a 2200 horsepower turbine locomotive for the Swiss Federal Railway.

In November 1948, Alco-GE #101, America's first attempt at this type of locomotive was completed. Burning a low cost, cheap grade Bunker "C" fuel oil, the 4500 horsepower dual service locomotive was double-ended and of streamlined design. Because Bunker "C" oil is very thick and must be hot in order to flow properly, the locomotive had a steam generator for heating the fuel.

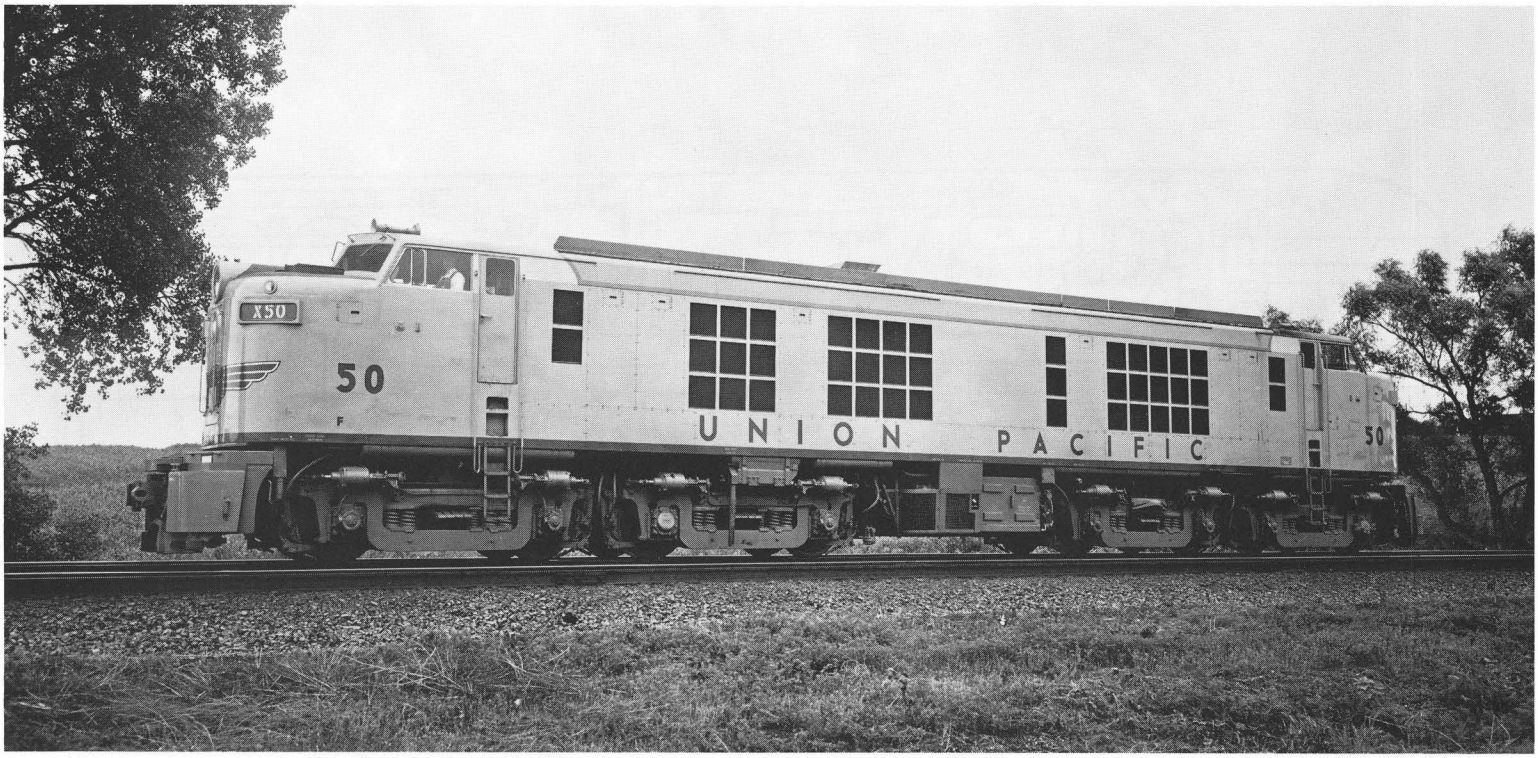
The gas-turbine power plant was developed, built and tested in the company's Schenectady Works. The rest of the locomotive was built and assembled complete with the power plant in the Erie Works. Tests in Erie were conducted early in 1949.

Painted dark green with yellow stripes, the "demonstrator" 101 initially made shakedown runs on the Nickel Plate and Pennsylvania railroads. On June 16, 1949, GE announced that it was being sent to the Union Pacific for extended testing in regular service.

Repainted the traditional U.P. colors and renumbered #50 at the GE Erie plant, the unit was sent westward to open a new railroad frontier in motive power design. Its first run was to the Pacific Northwest with a long freight train trailing several heavyweight passenger cars, including four official's business cars. It was next run in regular revenue freight service between Los Angeles and Salt Lake City for high altitude and hot weather testing.

Tests with #50 were conducted over all the road's main lines, from Council Bluffs to Los Angeles, Portland, and Seattle with a side trip to Denver. Eventually a few test runs were also made on the Kansas Division between North Platte and Kansas City. The most exhaustive tests were on the grueling Wyoming Division between Cheyenne and Ogden, Utah, where the U.P. lifts over Sherman Hill and the Wasatch mountain range.

During its 21 month stay on the Union Pacific #50 ran 101,231 miles of trials in every type of service before tests ceased on April 1, 1951. The gas turbine had pulled 349,608,463 gross ton-miles on 1,505,084 gallons of fuel oil. It was loaned to the Southern Pacific for a short



Union Pacific Railroad

When #50 first arrived on the Union Pacific, the company photographers took the usual publicity photos. This one, in color, appeared on the 1950 U.P. calendar. The original gas turbine was 83' 7½" long, weighed 534,000 lbs. in working order, and developed a starting tractive effort of 126,500 lbs. The dual service locomotive had 42" drivers, a B-B-B-B style wheel arrangement, and was geared for a maximum speed of 79 miles per hour. The fuel capacity of 6,670 gallons of heavy oil was enough for twelve hours operation.

T. M. Hotchkiss

The original gas turbine was tested extensively on the South-Central District, and #50 is shown near Devore, California, March 15, 1950, after cresting Cajon Pass with a westbound manifest. #50 developed 77,800 lbs. continuous tractive effort at 18.2 miles per hour and handled 4,400 tons on ruling 0.82% grades without a helper.

time before returning to GE's Erie plant for modifications. Although it never returned, it had left behind an impressive record. Much had been learned during its two years of demonstrator trials.

Performance wise, the "Big Blow", as gas turbines were called, was even better than expected. The inevitable "bugs" were not excessive. Design engineers realized the turbine power plant could not be shut down in service while idling or standing in yards without cutting off the air pumps. This was solved by adding motor driven air compressors. And although the 83' 7½" locomotive was built with two cabs, it was never so used in service following modifications to the exhaust system.

There had been considerable apprehension about what might occur during operation through tunnels with respect to recirculation of the exhaust gases. Generally those fears were unfounded as the turbine performed without difficulty through the numerous tunnels, longest of which is 6,700 feet. The dreaded "flame out" did find ideal conditions for trouble, however, in two tunnels in Echo Canyon. The tunnels have 1.14 per cent grades and lie almost perfectly aligned with the prevailing winds in the area. U.P. found that when an eastbound train was slowed by the grade to about twelve miles per hour and the wind was blowing at fifteen miles per hour, the turbine was being killed because exhaust was being blown forward and caught up again by the air intake. A turbine needs lots of fresh, cool air to be efficient. It will lose about 300 horsepower with each ten degree increase in surrounding temperatures.

To stop stalling in the tunnels, a deflector was mounted to direct the exhaust gases at a 30 degree angle toward the rear. As an additional precaution, it became practice to operate the turbine at the maximum RPM when entering tunnels in order to set up a flow of air toward the locomotive as the angle of the exhaust duct helped provide an entraining action. The double cure worked, also eliminating a problem in Hermosa tunnel.

Performance on grades was good with the locomotive handling 4,400 tons over 0.82 percent grades at satisfactory speeds. Riding qualities were also good. The combination of 2-axle trucks coupled with a span bolster and the relatively long centerplate distance on the main cab minimized the vibration and oscillation often found in some types of motive power.

The characteristics of the locomotive were somewhat strange to the operating crews, although its manipulation followed diesel practice very closely. Early in the test period there was considerable criticism from the crews about the noise of the turbine, however, some changes were made in the deflection of the exhaust and the noise level decreased.

Servicing of the locomotive was somewhat awkward because of the location of the fuel fill openings on top ahead of the operating cab and the excessive number of sand boxes. The locomotive was shopped several times for design changes or repair of failed equipment. Its over-all availability, discounting design changes, was approximately 70 percent.

An odd feature with gas turbines is that power output varies considerably with altitude and ambient temperatures. It is more efficient at lower temperatures (cold air is denser, and the compressor can force more air into the combustion chambers) and can deliver from

J. A. Rutherglen Collection

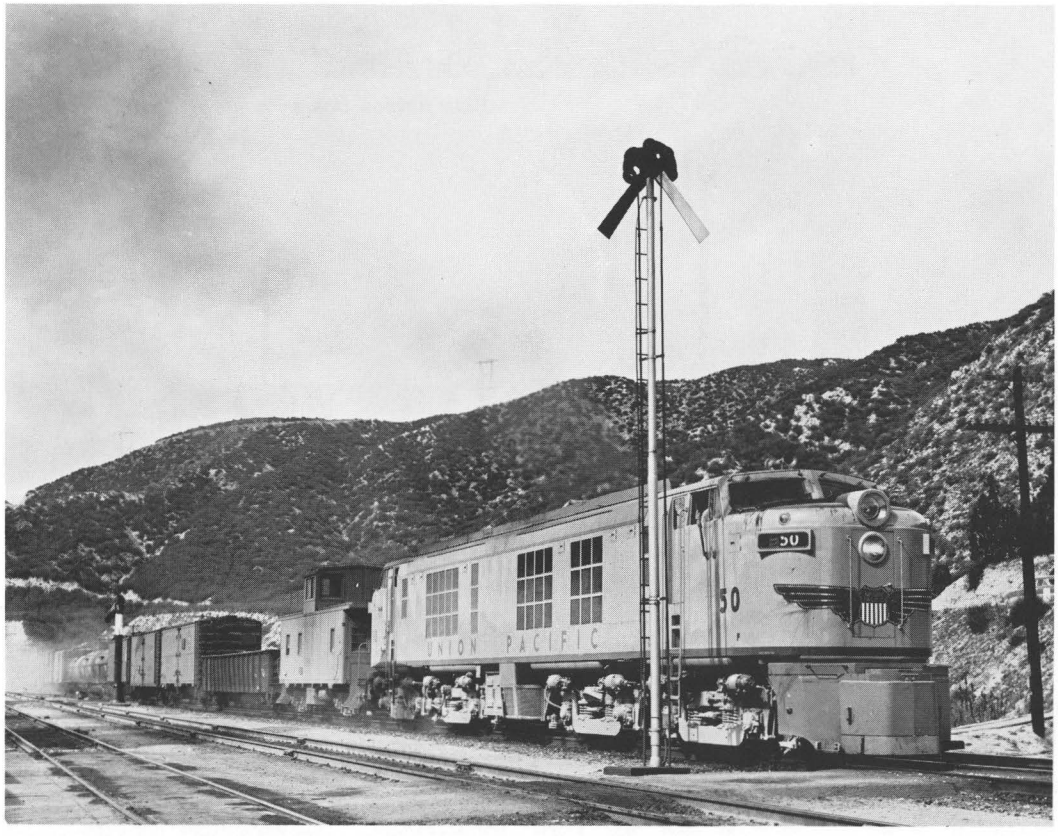
The experimental Alco-GE #50 is shown taking a siding in the Blue Mountains of eastern Oregon on August 4, 1949. The mixed consist includes several heavyweight passenger cars which served as enclosures for the General Electric test equipment. Note the fence-like ridges on both edges of the locomotive roof.

The first day the experimental gas turbine was shown to the public at Los Angles was August 20, 1949, at the U.P. freight depot. Long lines of viewers were common at all points where the locomotive was exhibited. (Right) On that day, Nelson Pringle of CBS NEWS interviewed (l to r) William M. "Bull" Jeffers, who was President of the Union Pacific from October 1937 to February 1946; Arthur E. Stoddard, U.P. President from March 1949 to January 1965; and William Reinhardt, Vice President of the U.P's Oil Division at that time. All further experiments and purchases of turbine locomotives on the Union Pacific occurred during the tenure of Mr. Stoddard, who favored the use of modern giant power.

Both photos Union Pacific Railroad

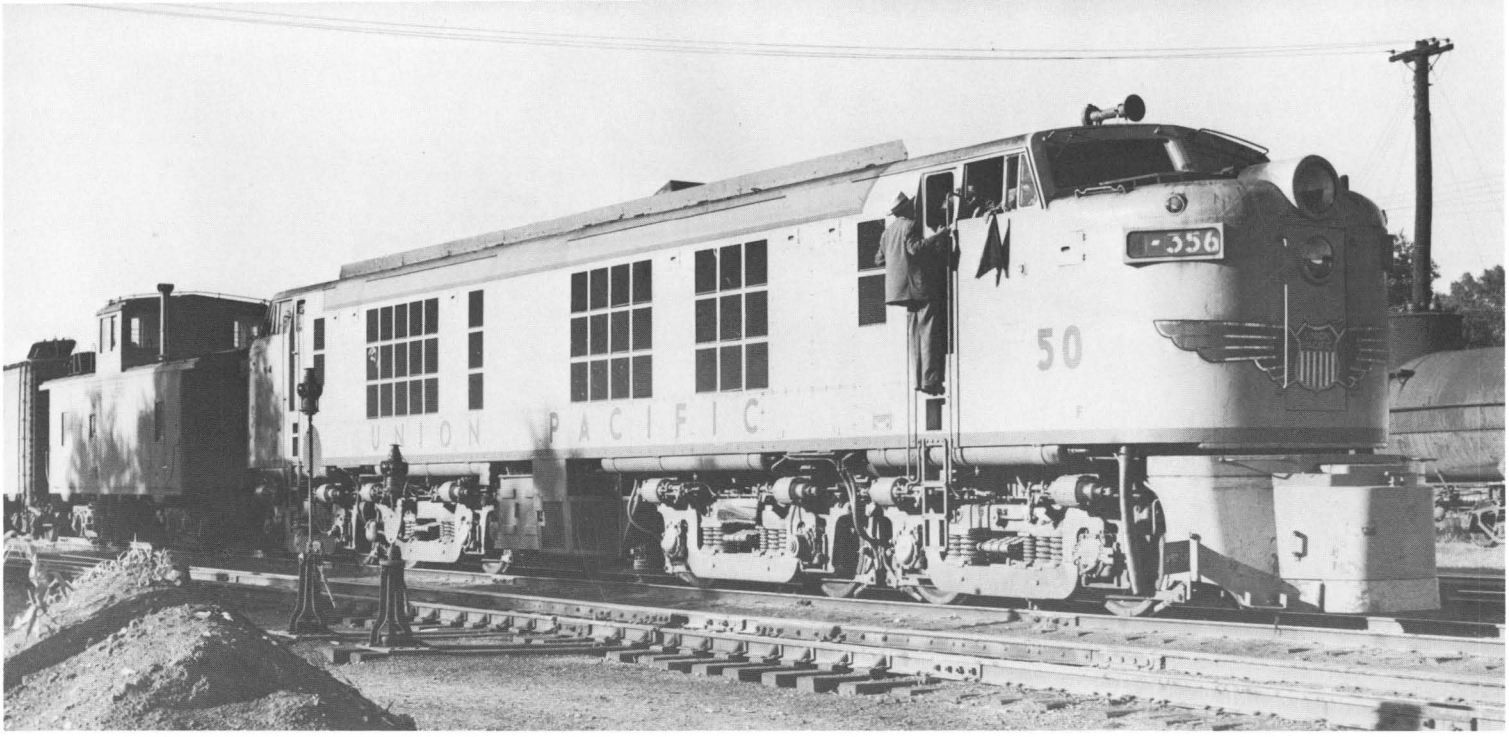
Wm. W. Kratville

Start to the Turbine Era! Number 50 is shown leaving Omaha, Nebraska, at 36th Street, shortly after noon on July 30, 1949, with the first revenue test run of the experimental gas turbine on U.P. rails. The consist included baggage car 1797, chair car 2783, and business cars 124, 121, 123, and 100, followed by 10 revenue freight loads and 59 empty reefers.



T. M. Hotchkiss

Number 50 rolls downgrade past the train order board at Cajon station with a westbound on March 15, 1950. The U.P. crosses scenic Cajon Pass in southern California on Santa Fe trackage.



Byron E. Guise

Flying green flags, #50 prepares to leave Marysville, Kansas with 4-356, an eastbound "Green Fruit", on one of its test runs to Kansas City in October 1950. Kansas Division trainmen were impressed with the power of the gas turbine, which outpulled the famed 9000 class 4-12-2's on the hills.

Union Pacific Railroad

The original gas turbine electric saw twenty-one months of trials in every type of service, including passenger train helper service on Sherman Hill. 1-3, the "Idahoan" with 15 cars, is making good time west of Borie as the turbine gives the 820 class 4-8-4 road engine a helping hand.

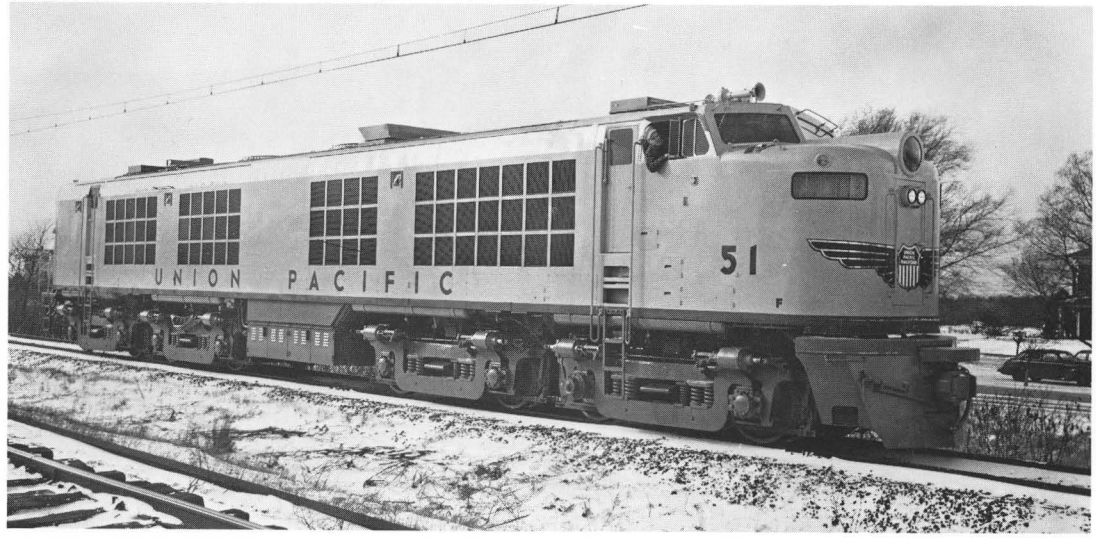
Lewis Harris photo, Stan Kistler collection

Flying white flags, #50 waits at San Bernardino, California, on September 13, 1949.

10 to 20 per cent more power in cold weather than in extremely high summer temperatures. Tests with #50 showed that under "ideal" conditions the power output increased to over 5500 horsepower. The 4500 horsepower rating was determined for operation at 1500 ft. elevation and 80 degrees Fahrenheit.

From the experimental locomotive stemmed an order in March 1951 to General Electric for ten 4500 horsepower turbines designed specifically for the Union Pacific and embodying the lessons learned on the first unit. They were numbered 51 to 60 and were almost identical in appearance to the 50 except for having only one cab. Elimination of the rear cab and a slight rearrangement of the interior components allowed an increase in fuel capacity.

The first of the new class, #51, arrived at Council Bluffs on January 28, 1952, and after the usual U.P. general shop inspection and customizing, was placed on public display at the Omaha Union Station January 31. It then proceeded west to enter regular pool service between Ogden, Utah, and Green River, Wyoming. The additional units were also assigned there as the cooler climate and long trains, coupled with the 176 mile mountain run, offered the best testing ground in actual service. There are 65 miles of 1.14 per cent grade eastbound, while the ruling grades over the balance of the district do not exceed .82 per cent east and westbound. The turbines were handling on occasion up to 5,000 tons on the 1.14 per cent eastbound grade and up to 5,600 tons over the .82 per cent westbound grades without a



General Electric

The first production gas turbine, #51, is shown January 23, 1952, on the GE test track at Erie, Pennsylvania, during final trials before being shipped west to the U.P. the next day.

Union Pacific Railroad

When the gas turbines first arrived on the system, they created a mild sensation with their distinctive jet-like sound. X-52 East is crossing the Green River bridge at the Wyoming sub-division point of the same name in the summer of 1952.

helper. In actual operating practice, however, helper engines were used eastbound from Ogden to Wahsatch, Utah.

The elevation on this district varies from 4,298 feet at Ogden, Utah, to over 7,200 feet above sea level at the top of the grade. Rated tonnage over this run was 4,890 tons for the .82% ruling grades without a helper engine, and the turbines were handling trains weighing up to 5,000 tons on a regular basis.

The first locomotives delivered were slippery on the front truck. This was overcome by ballasting and by the addition of a manually-operated power reduction switch in the circuit supplying the front pair of traction motors. In general the train handling abilities were better than that of the pilot locomotive.

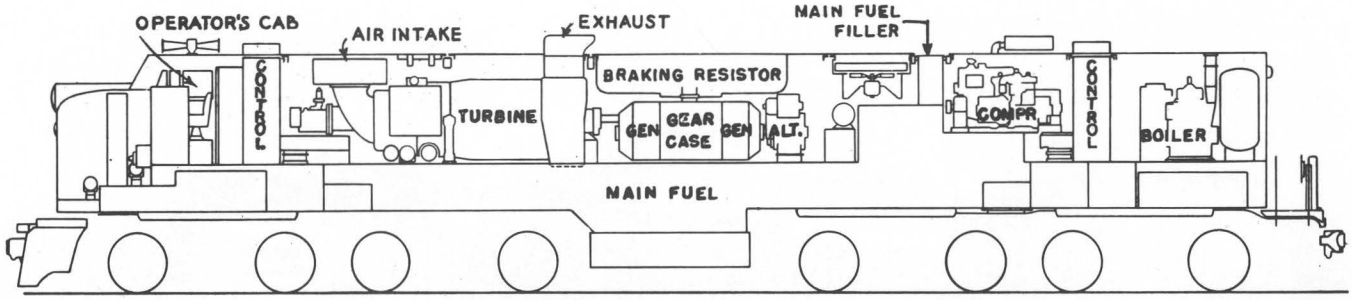
Several changes in design of the 51-60 class were made to improve the servicing conditions, in view of experience with the 50. The main fuel filling opening was moved to the mid-part of the locomotive. A dog-leg fuel tank was used to provide better filling flow characteristics through the length of the long tank. As a result fueling time, under the spouts, was reduced materially. The sanding requirements were reviewed, with the result that 8 of the 16 filling openings originally used were eliminated.

No preferred treatment was given the new type of power, and they turned in a remarkable performance — so good in fact that on December 11, 1952, after only six of the original order had been received, an additional order was announced with General Electric for 15 more 4500 horsepower turbine locomotives.

The second class, numbered 61 to 75, incorporated several improvements gained as the result of both experience on the road with # 51-56 and further advances in engineering. Notable among them was the moving of the air intakes from the sides to the roof, the elimination of side filters, and a dynamic brake which obtained its excitation current from the auxiliary generator and alleviated the necessity of running the turbine at full power while going downhill. Changes were also made to the oil filter system, and terminal hostling was switched to the No. 3 motor rather than No. 4, as on the first ones.

In appearance, they utilized a road-switcher style carbody with exterior walkways built into a recessed area along each side of the locomotive. Because of the open catwalk, they were nicknamed the "Verandas."

Moving the air intake to the roof was first successfully tested on # 53, and subsequently all of the original six locomotives were converted in 1953. Numbers 57 to 60 were delivered from May to August 1953 with the modifications already made.



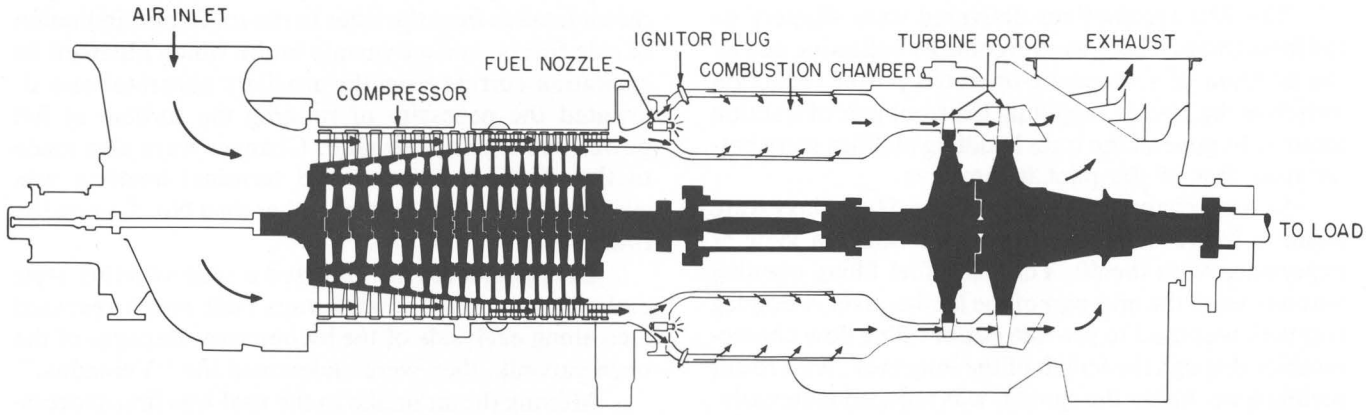
This cutaway side view of the 4500 horsepower gas turbine electric locomotive shows the layout of the interior apparatus. The structural base of the unit was formed by the 7,200 gallon fuel tank. The carbody rested on two span bolsters, under each of which were two four wheel powered trucks.

Application of the gas turbine principle is neither new nor uncommon — the jet aircraft engine is a familiar form — and has a history longer than any internal combustion engine. It was invented by an Englishman named Barber in 1791, when railroads were scarcely dreamed of. Barber conceived the idea of drawing in air from the atmosphere, compressing it, heating the compressed air by direct burning of fuel in it, and utilizing the hot compressed air to perform work as it re-expands to atmospheric pressure.

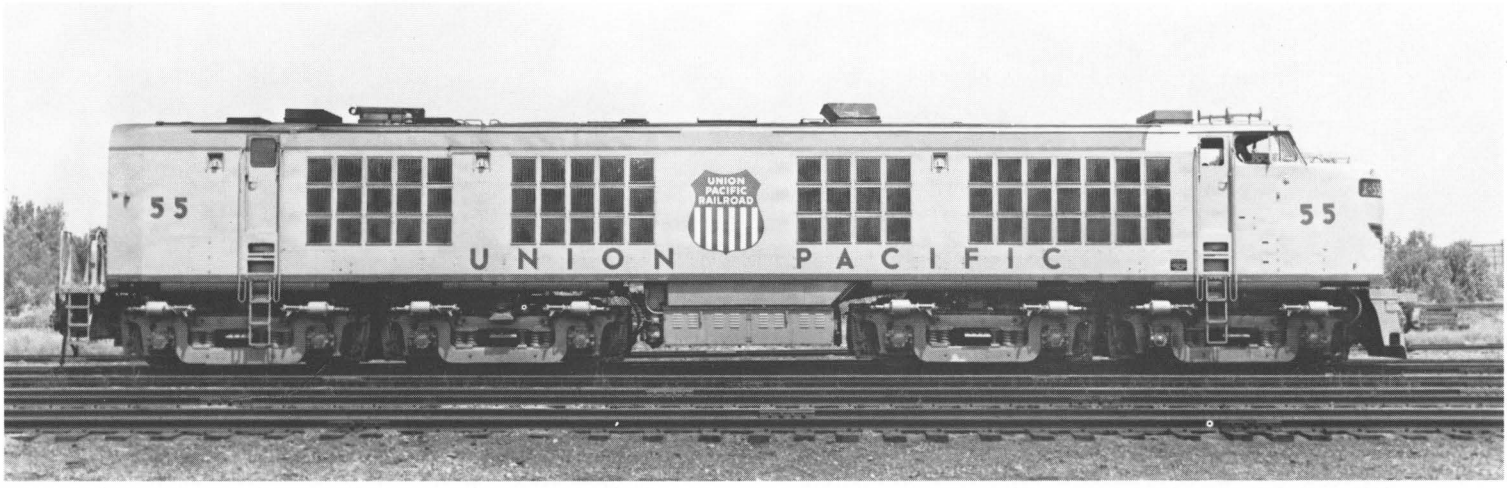
Basically, the 4500 horsepower gas turbine electric locomotive worked this way. Atmospheric air was compressed to approximately six times normal pressure by a 15-stage axial-flow compressor mounted on the turbine shaft. This compressed air entered six combustion chambers where fuel oil, fed by an oil pump, was injected and atomized through nozzles into the air. Spark plugs fired the fuel in numbers one and six burners, while the other four burners were fired by cross-fire tubes connecting them all together. The resulting hot gases expanded tremendously, moving at great velocity against the curved blades of the two stage turbine, causing the drive shaft to spin. The shaft then drove, through reduction gears, the four direct-current electric generators which supplied power to eight traction motors, each of which drove one of the eight axles on the B-B-B-B style running gear.

The gas turbine powerplant was similar to that of the jet engine, except there was no jet "thrust" to the atmosphere for propulsion as in a plane. The air intake and exhaust system was also similar, and the noise created by the gas turbine locomotive, while not excessive, was also similar — thus the name "Big Blow." Whereas the exhaust noise seemed considerable at close range, it dissipated sharply with distance because the sound had no dominant pitch. Actually locomotives #51-75 were quieter than the prototype #50, with new methods of air compression and different filters making the difference. Conversation could be carried on in normal voice in the locomotive cab, and the comparative absence of vibration from the power plant was very noticeable.

Besides the 4500 horsepower turbine engine, each locomotive also contained a small 250 horsepower diesel engine. It was used to bring the turbine up to a firing speed of 700 RPM, to run the auxiliaries, fans, pumps, and cooling motors, and to move the locomotive around terminals when running light. The diesel engine could power the locomotive at a maximum speed of 25 miles per hour on level track. Diesel fuel was used



Air flow diagram of the gas turbine engine in the 4500 horsepower turbine locomotive. About 150,000 cu. ft. per minute of exhaust gases were discharged through the roof opening at a velocity of approximately 150 miles per hour and 850 degrees Fahrenheit.



Union Pacific Railroad

The 51-60 series locomotives weighed 551,720 lbs. and packed 137,930 lbs. starting tractive effort. 40" wheels and a 74/18 gear ratio permitted the 4500 horsepower freight haulers a maximum 65 miles per hour and 105,000 lbs. continuous tractive effort at 12.9 miles per hour. The locomotive was 83' 6½" long and had an extreme height of 15' 5¾". The fuel capacity of 7,200 gallons heavy oil gave the pre-tender turbines a range of 400 miles. The unit also had a 1,000 gallon capacity for diesel fuel.

Union Pacific Railroad

In the cooler climate of the snow sprinkled Wasatch range, the turbines produced more than their rated 4500 horsepower. Before being placed in service, #52 received a change in appearance when chrome grills were added to protect the side air intake filters.

Union Pacific Railroad

The Union Pacific uses left hand operation in the lower reaches of the Wasatch range. Gas turbine 53 is coasting down the one percent grade east of Devils Slide, Utah, in the summer of 1952 with a westbound manifest.

to start the turbine and to bring it up to 80 per cent of its 6,900 RPM maximum, at which time modified No. 6 heavy black fuel oil was cut in. The black turbine oil was generally referred to as Bunker "C" oil, but the fuel was actually different from regular Bunker "C". Normal idling speed of the turbine was 5,200 RPM.

The main fuel tank had a capacity of 7,200 gallons of heavy oil, with the theoretical fuel consumption rate averaging 600 gallons per hour in full throttle, full load conditions and 200 gallons per hour at idle, no load. The heavy oil in the main fuel tank was maintained at a temperature of 110 degrees Fahrenheit by means of a conventional Vapor-Clarkson steam generator plus heating coils in the bottom of the fuel tank. Temperature of the oil was raised by a heater before it passed through fuel filters, and the oil was about 240 degrees Fahrenheit when it reached the fuel pump. The fuel filters were cleaned automatically by steam from the steam generator by means of a differential pressure switch which was activated whenever the output through the filters was 10 pounds less than the input pressure.

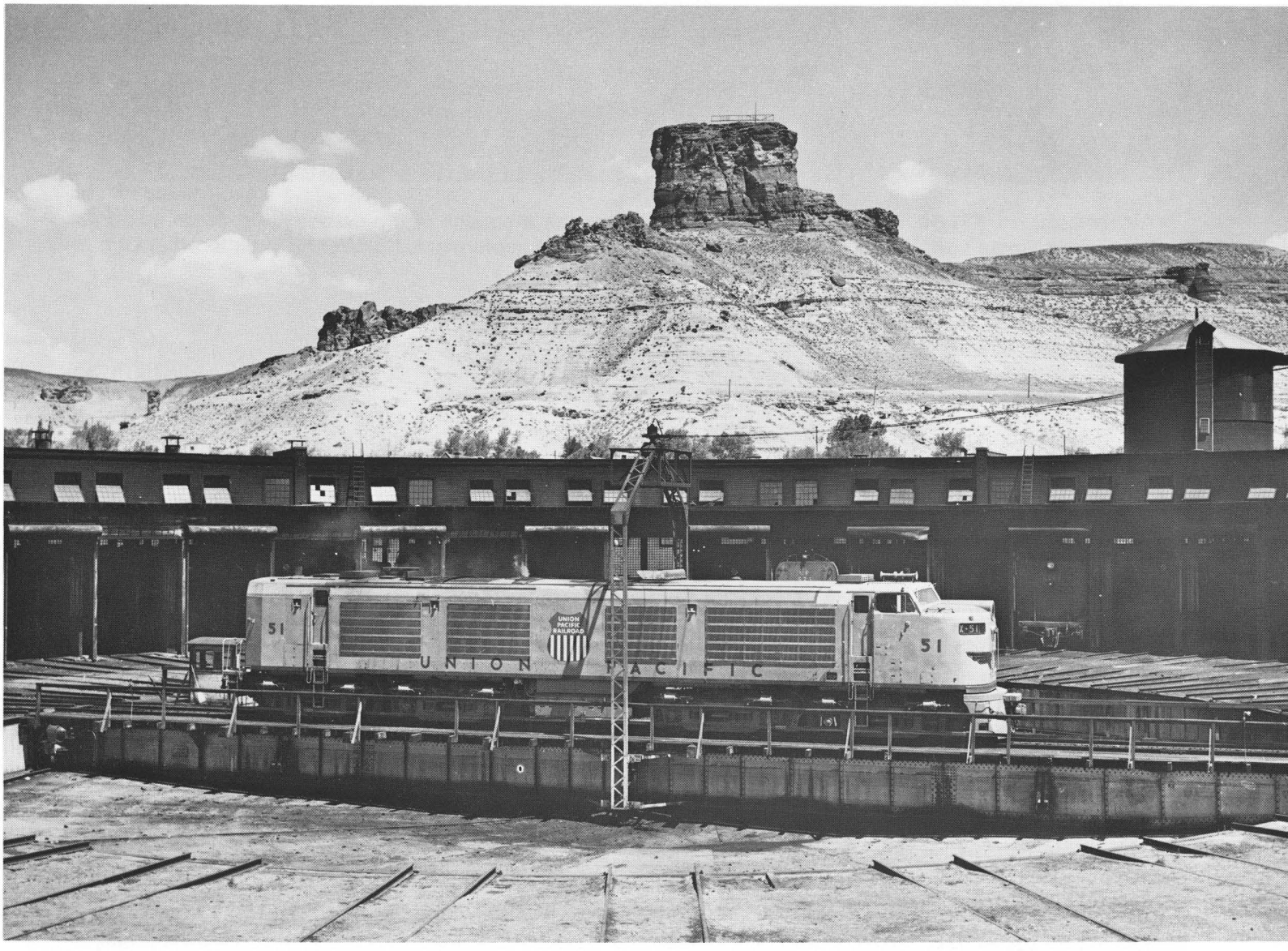
Shutting down a gas turbine was practically the reverse of the starting process. Diesel oil was transferred to the fuel lines to purge the turbine fuel oil before the burners were shut off.

Gas turbine and diesel-electric locomotives were similar in principle except for the prime mover of the electric generator, and the design of the turbine locomotive included as far as practicable diesel-electric trucks, traction motors, and controls.

One difference in the controls was the throttle where the turbine had twenty notches compared with eight on the diesel. It was especially noticeable when the engineer wanted to accelerate rapidly, and the throttle sounded a quick succession of "clicks."

The last of the twenty-five GTEL-4500 class, #75, was delivered October 28, 1954. Total cost of the 25 locomotives was over 14 million dollars, #51-60 averaging approximately $540,000 each and #61-75 averaging $573,500. In their first full year of operation, these 25 locomotives handled nearly 10% of all U.P. freight train-miles. Each turbine averaged approximately 10,000 miles per month, pulling almost 110,000 gross ton miles per freight train hour. Average turbine hours per month was about 400. Overall availability was more than 80 per cent.

The turbine locomotive demonstrated an ability to move 6 to 8 miles per hour faster than a 4500 horsepower diesel with an equal train. Enginemen noted that from a standing start, with equal loads, the turbine could attain sixty miles per hour in three miles less



J. A. Rutherglen Collection

With Castle Rock in the background, turbine 51 rides the 135 foot turntable at Green River, Wyoming, in the spring of 1952. Steam still ruled the Wyoming Division in that year, and 800's and 3800's were among the roundhouse occupants.

Union Pacific Railroad

Air for turbines #51-56, as originally built, entered through the sides of the carbody. The large openings insured an ample supply of filtered air for combustion in the powerplant. Number 55 is pictured at Omaha when delivered in late June 1952.

Thos. R. Lee

With new paint sparkling on a rainy afternoon, turbine 59 waits on the ready track at Laramie, Wyoming, August 21, 1957, for a westbound call.

distance than a three unit diesel rated at equal horsepower. Although not intended for passenger service, on at least one occasion, a gas turbine locomotive pulled in a streamlined passenger train after the diesel engine broke down. While not designed for multiple-unit operation either, they were occasionally double-headed, even through long tunnels where recirculation of the exhaust gases might be a problem with the second locomotive. Once, as a result of a defective drawbar on the rear, a gas turbine was operated backward through a tunnel without difficulty.

In their first year of operation, the locomotives averaged approximately 4.2 gallons of total fuel per 1,000 gross ton miles. Further figures show that fuel consumption averaged 14 gallons of heavy turbine fuel and .85 gallon of diesel fuel per locomotive mile or 333.9 gallons of heavy fuel oil per turbine hour.

The Union Pacific was so satisfied with the turbine's performance that on November 30, 1955, the road again placed an order with General Electric, this time for fifteen 8500 horsepower gas turbines, the most powerful locomotives in the world, an order that eventually was increased to thirty locomotives.

Numbered 1 to 30, the new two-unit locomotives differed considerably from the 51-75. Besides horsepower, the major difference was design simplification. The C-C style running gear eliminated the span bolster used in the earlier units, provided a better traction motor ventilating system, and improved maintenance accessibility. The two-unit locomotive, with cab at one end only, had a 10,700 horsepower turbine, producing 8,500 horsepower input to the generators and 7,000 horsepower at the rail. The 8,500 horsepower rating was arrived at for ambient conditions of 6,000 feet elevation and 90 degrees Fahrenheit.

The lead unit housed the engineer's cab, control cabinets, dynamic brake resistors, air compressors, and an 850 horsepower Cooper-Bessemer diesel engine. The diesel was used to start the turbine, to provide excitation of the dynamic braking, and to move the locomotive when the turbine was not needed. The second, or "B", unit contained the main power plant, a single shaft gas turbine unit with ten combustion chambers, and two 3,500 horsepower generators which powered the traction motors. The units were coupled with tight-lock couplers and were not intended to be disconnected in service. For all practical purposes the units were permanently coupled. The GTEL-8500 class locomotives were 178 feet, 11¼ inches in length, including the trailing fuel tenders of 24,384 gallon capacity, which were rebuilt by Union Pacific from retired 800 class and 3800 class steam engine tenders.

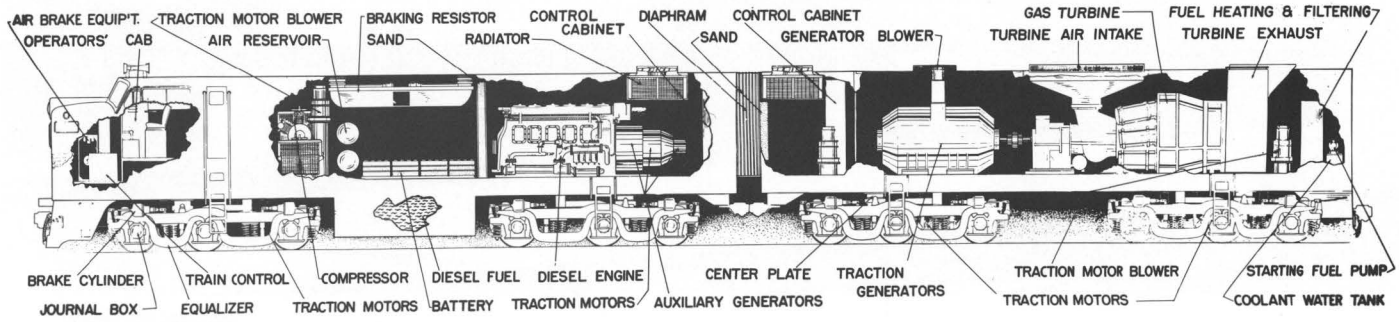
The first of the "Super Turbines" made its initial trip west from Omaha on August 31, 1958. The last, #30, was delivered in late June 1961. Only a year later, a program of upgrading was started that resulted in the original 8500 horsepower rating being increased to 10,000 horsepower for many of the locomotives. Several of the newer locomotives were further equipped for multi-unit operation with diesels. By April 1966, twenty-five of the giants had been so equipped and multi-unit operation with diesels became common practice as more horsepower was assigned to the growing fleet of faster moving freight trains.

William A. Gibson

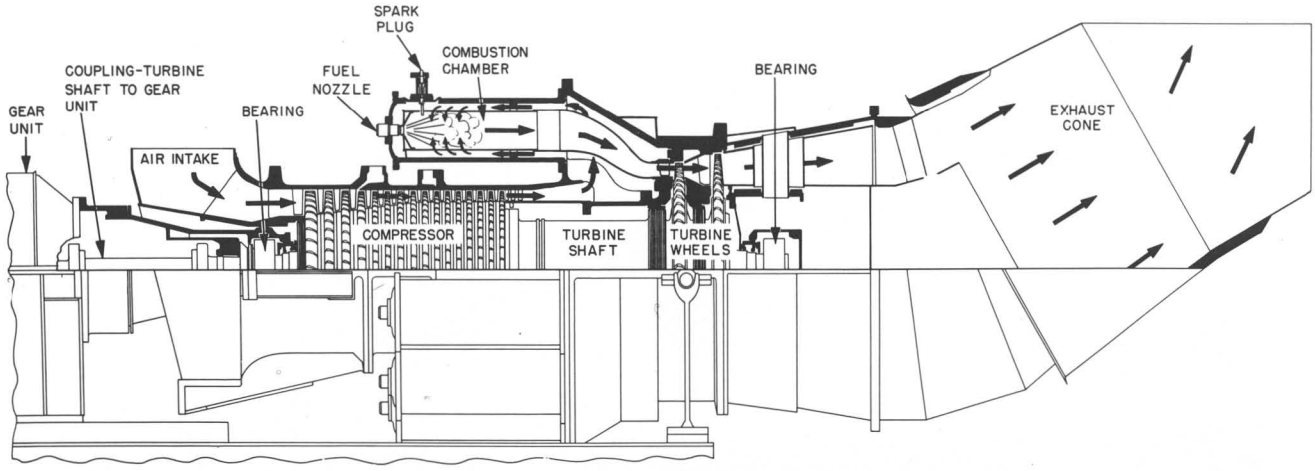
The catwalks were unique to the second series turbines, dubbed the "verandas." All 25 of the 4500 horsepower turbines were delivered to the U.P. in numerical sequence, except for #63 which arrived several days after #64, shown here at Ogden, Utah, in the afternoon of August 23, 1954.

Union Pacific Railroad

"World's Most Powerful Locomotive" weighed 849,248 lbs. without tender and developed a starting tractive effort of 212,312 lbs. The C-C style trucks had 40" wheels to go with a 74/18 gear ratio, giving a maximum speed of 65 miles per hour. At 18 miles per hour, the giant developed a continuous tractive effort of 146,000 lbs. The 8500 horsepower three-unit locomotive was 178 feet, 11¼ inches in length, including the trailing insulated fuel tender of 24,384 gallon capacity. When originally ordered, the big turbines were to be numbered in the 7000 series, and scheduled delivery was to start in mid-1957. Early "bugs", however, set the time table back a year. The locomotives, minus tender, cost approximately $845,000 each. Compared to the earlier turbines, the 1-30 series had several design simplifications. C-C trucks eliminated the span bolster. The steam generator with related equipment was eliminated by use of the insulated tender. The turbine prime mover had new combustion chamber design, giving easier accessibility. The cab unit was 69 feet 6 inches long, the "B" unit 63 feet long, and the tender 46 feet 5¼ inches long. The total locomotive was designed for 21 degrees maximum curvature operation.



Cut-away of the 8500 horsepower Gas Turbine Electric Locomotive built by General Electric. The two units were coupled permanently, the front unit housing the accessory equipment and the back unit the main turbine powerplant and generators.



Air flow diagram of the gas turbine engine in the 8500 horsepower turbine locomotive.

Wallace W. Abbey

When a new locomotive first arrives that is as big, beautiful, and unique as the "Super Turbine", it is photographed both day and night. The brand new giant is outside the Council Bluffs, Iowa, diesel shop on October 21, 1958.

Union Pacific Railroad

When #57 was delivered in May 1953, the complicated fuel oil supply equipment was removed and the turbine adapted to burn propane gas on an experimental basis with the Richfield Oil Corp. Used between Los Angeles and Las Vegas, the locomotive was equipped with a special tank car tender, GATX 75224. (Above) The first test run was a caboose hop between the East Los Angeles yard and Bly, California in late May.

All of the 51-75 class were also eventually equipped with fuel tenders. The tender from the first scrapped 4-8-4 steamer, the 806, was rebuilt into a turbine tender for tests with #61 in October 1955. Later turbine tenders for the 51-75 series were made by using the running gear and frames from 18,000 gallon tenders from the scrapped 9000's and by splicing the water compartments from two tenders back to back on a single frame. Use of the 24,000 gallon auxiliary insulated tank tender enabled the 4500 horsepower turbines to easily operate the 992 mile Ogden to Council Bluffs run without refueling. The locomotives could actually be operated back to Cheyenne on the return trip before refueling was necessary. With the capability to make longer runs, the turbines soon showed an increase of almost 30% in their total monthly mileage. Tenders also gave the locomotives the additional advantage of keeping locomotive weight constant on the drivers instead of losing weight and traction as the fuel was burned.

Although the turbines were originally designed to burn low cost, treated residual fuel oil, the U.P. felt the fuel was too heavy and fraught with difficulties in heating and handling. The problems Bunker "C" created with fuel pumps, nozzles, heating equipment, and turbine blade corrosion encouraged the road to also try other fuels.

Fuels ranging from 200 viscosity residual fuel oil to liquid propane gas were tested in the turbine. When #57 was delivered, the turbine was adapted to burn propane gas on an experimental basis with the Richfield Oil Corp. Equipped with a special pressurized tank car tender, the unit was placed in test service between Los Angeles and Las Vegas, Nevada, and made its first revenue run burning propane gas on May 31, 1953.

The experiment was a technical success. There was less wear on the turbine blades as propane burns clean and leaves no carbon deposit as residue. Propane is highly volatile, however, and the required extra safety precautions seemed to offset the advantages.

The operating range of the propane turbine was 500 miles. Fuel consumption proved to be roughly 23 gallons per mile, and the tender was loaded to only 11,300 gallons, a differential, from the 12,500 gallon maximum, that was adhered to for safety reasons.

To minimize the possibility of puncture to the tender in the event of a derailment, the inner propane container, constructed of ⅞'' thick steel, was covered by a four inch layer of cork insulating material and a ⅛'' thick outer shell.

The tender also used a heat exchanger, a sort of radiator, through which steam was passed to further increase the pressure under which the liquid propane was confined. A minimum 150 pounds per square inch of pressure was necessary for normal operation.

Safety devices were also designed to operate in conjunction with the tank car air brake system. In the event of a system breakdown, possibly because of a derailment, passage of the propane gas to the power unit was instantaneously shut off.

A rider caboose was hauled behind the turbine

Union Pacific Railroad

U.P.'s first super turbine makes a pretty picture as it curves its way into Echo, Utah, with a long eastbound extra on one of its first runs in early September 1958. Compared with diesels, the turbines had more personality and were truly unique.

Robert H. Heuerman

At one of the most photographed spots in railroading, propane burning turbine #57 works through the curves at Summit, California, on Cajon Pass with a westbound extra in July 1953. Although the use of propane was a technical success, it required special safety precautions that negated the advantages.

tender, and either Ross C. Hill or Richard E. Prince of the Motive Power turbine staff normally rode each round trip between Los Angeles and Las Vegas. In an effort to lower fuel costs, the turbine prime mover was shut down during downhill runs or while waiting in passing tracks. This practice required restarting the turbine numerous times on each trip. Operating costs did not compare as favorably as originally hoped for even though propane sold for $1.20 a barrel vs. $1.75 a barrel for regular turbine fuel oil. The LPG fuel was hauled to Las Vegas by truck, and the final fuel costs precluded propane gas being used on more than turbine #57.

On New Years Day 1954, a turbine bucket failure on #57 caused considerable damage to the turbine prime mover. When repaired, the locomotive was converted back to regular turbine fuel oil.

Number 60 was also operated in tests with a low viscosity black fuel oil which came from the Carter Oil Co. of Billings, Montana. This black oil was an ideal fuel for turbine use as it required no heating, however, it was also too expensive to be considered for full time usage.

In later years a lower viscosity fuel oil was available from refineries in Utah, Wyoming, Colorado, and Kansas; and this fuel proved to be satisfactory when used at an operating temperature of 185 degrees Fahrenheit.

The .0032 inch fuel filters were not adaptable to fuels with a thick consistency, and the trouble lessened only as a less "gummy" fuel was used. The original fuel nozzles on the experimental #50 worked only ten hours before they needed cleaning. Redesigned, the pintle vortex nozzle went fifty hours without maintenance. The air-swirl nozzle installed on the 4500 horsepower turbines in mid-1955 was dramatically more successful, as the nozzles were normally cleaned only during regular monthly inspections after 400 or more hours of operation.

In 1958, with the expected arrival of the new "Super Turbines", and the continual search for more horsepower, the U.P. began several tests with turbine-diesel multi-unit combinations using turbine #61. Eventually, all but six of the 4500 horsepower

locomotives were equipped for multi-unit operation with diesels.

A double turbine combination, #59 and 60, with a single joint fuel tender, was also used from July 1958 until the end of November 1958. The locomotives ran tests for the purpose of evaluating the effective operation of paired turbines to double locomotive horsepower. The 9,000 horsepower combination worked fine except in tunnels where the lead unit would sometimes suck out all the air and the trailing unit would die or lose power as a result of inhaled exhaust from the lead unit. After modifications were made in the first few weeks of operation, the tests were considered improved, although never fully successful. Starting in August, turbine 60 always ran as the lead unit as #59 had been modified to operate as the trailing unit in tunnels. It took air from inside the carbody while in a tunnel, but high exhaust temperatures still resulted in a loss of power. If a shut-down did occur on #59 during operation, the turbine could be restarted without stopping the train. When powered up at terminals, each turbine was fired separately and one at a time. When the decision was made to multi-unit the turbines with diesels rather than use turbine combinations, #59 and 60 were separated and returned to single locomotive operation.

Trains: Wallace W. Abbey

Union Pacific Railroad

A double turbine combination, #59 and 60, with a single joint fuel tender, was a 9,000 horsepower good idea except for tunnel problems. This photo was taken at Omaha in July 1958 when the locomotives were mated with one of the big tenders later used with the 8500 horsepower turbines. Turbine 59 would soon receive a "raised" air intake housing unit and be used as the trailing unit only.

Union Pacific Railroad

Coal burning gas turbine electric #80 was built at the Omaha shops as an experimental locomotive. The 7,000 horsepower three-unit monster was 214 feet 9⅜ inches long and could negotiate a 12½ degree curve. Fully loaded and with tender, the locomotive weighed 1,457,280 lbs. and had a starting tractive effort of 188,107 lbs. The locomotive had dynamic brakes and was equipped for multi-unit operation with both leading and trailing diesel units. This photo was taken at Omaha in October 1962 when the engine was first placed in test service.

Even after the arrival of the 8500 horsepower giants, the U.P. was to have one more fling with a turbine experiment. The next logical step was to locate a gas turbine that could feed satisfactorily on the abundant coal supplies owned by the U.P. in Wyoming. In early 1959, a work order was issued to "design, construct, and test" a coal-burning turbine-electric locomotive at the Omaha shops. Construction of this experimental engine began in earnest in September 1959 with the arrival of an ex-Great Northern electric to serve as the carbody for the turbine unit. Since the locomotive was practically being designed as it was built, work on it and its accompanying X-3990 coal tender progressed rather slowly, with testing of each component as it was added. In March 1961, an Alco ex-passenger diesel unit was sent to the shops to be fitted as the control unit for the cabless turbine. This "A" unit and the tender were the first to be completed in the summer of 1961, with the turbine unit completed in November and initially tested with diesel fuel on December 1. Number 80, a 7,000 horsepower three-unit monster, 214' 9⅜" long, had come alive. The turbine was started on diesel oil and could operate on either diesel fuel or the pulverized coal for which it was intended, so early stationary tests were made using the easier fuel, and it was not coal fired until April 19, 1962. Stationary tests continued until October, removing many of the bugs that are inherent in any original design. The big day finally came on October 17, 1962, when the turbine was first road tested, taking a train to Grand Island, Nebraska, with two diesel units coupled behind for protection power only.

A background analysis of the locomotive shows the "A" unit was originally 2000 horsepower Alco PA-1 passenger unit #607, the last of four delivered to the U.P. in January 1949 and later regeared for freight service in the summer of 1955. The unit had a new 20-step control system installed for itself and the turbine, but retained the original diesel equipment for added power and moving the locomotive when the turbine was shut down in terminals. Air compressors with reservoirs were mounted on the roof and supplied air to both the "A" and "B" units. A large, protruding turbine fuel oil tank was installed in the rear, replacing the former train-heating boiler. The control system was modified for multi-unit operation with a diesel lead unit and/or diesel trailing units.

The "B" unit was originally a straight electric locomotive delivered to the Great Northern in June 1947 as #5018 and retired in August 1956 when G.N. electrified territory was eliminated. Rebuilding included removal of traction motors from the leading four-wheel trucks at each end, leaving only the eight center axles powered. The unit contained electrical equipment in front followed by the main generators, which were connected to the turbine, a 4500 horsepower unit (serial #97631) previously used 27,314 oil fired hours in one of the GTEL-4500 class locomotives,

All photos Union Pacific Railroad

The cab control unit of the coal turbine was originally 2000 HP Alco PA-1 passenger diesel #607 delivered to the U.P. in January 1949. As rebuilt in the summer of 1961, the unit weighed 363,180 lbs. fully loaded, 243,330 lbs. on drivers, and developed 60,832 lbs. starting tractive effort. The protruding fuel tank at the rear of the unit held 3,852 gallons of turbine oil. Four additional air reservoirs were mounted on the roof, supplying air for both units.

The 80B turbine unit was built using ex-Great Northern electric #5018 for the carbody. 80B weighed 733,100 lbs. fully loaded, 509,100 lbs. on drivers. The 2-D+D-2 wheel arrangement had 40" wheels, a 74/18 gear ratio, and developed 127,275 lbs. starting tractive effort. The 5000 horsepower unit was 101 feet long and had an extreme height of 17 feet 7 inches. The turbine exhaust was located in the roof above the "FIC". The exhaust gases would exit at approximately 780 degrees Fahrenheit.

The tender for the coal turbine originally came to the U.P. in 1943 as a Class 25C-3 coal tender for #3990, a 4-6-6-4 steam locomotive. As rebuilt it held 61 tons of nugget size coal, enough for almost 700 miles of operation. Without fuel the tender weighed 222,400 lbs., fully loaded 361,000 lbs.

but overhauled and modified to a rated 5000 horsepower. The coal combustors and fly ash separators were just behind the turbine, followed by an auxiliary diesel engine which provided power for fans, blowers, and the coal pulverizing equipment in the tender.

The tender came to the U.P. in 1943 as a Class 25C-3 25,000 gallon, 28-ton coal tender for a 3985 Class 4-6-6-4 "Challenger." As rebuilt it contained automatic coal-handling and pulverizing equipment in the front portion and a hopper for 61 tons of nugget-size coal in the rear, enough for almost 700 miles of operation.

In operation, the coal was conveyed in the tender from the hopper to the magnetic separator (for removing metal objects), then to the coal crusher and pulverizer where it was processed and pumped through connection pipes to the combustors in the "B" unit and ignited. The resulting hot gases flowed through the fly ash separators, to remove foreign particles, then into the turbine.

Between October 17, 1962, and May 12, 1964, the date of its last revenue freight run, the coal-fired GTEL operated 21,848 miles in revenue freight service, of which 10,959 were on coal. The locomotive operated a total of 488 hours on coal, however, only 84 hours were on the first set of nozzles and buckets, with 404 hours of coal being used on the second set. In addition, the first set of nozzles and buckets operated 93 hours on oil, while the second set was used 53 hours on oil. The locomotive saw considerable service in the spring and early summer of 1963, being used as far west as Cheyenne. On May 14, 1963, U.P. President A. E. Stoddard was quoted as saying that 50 test trips had thus far been made by the coal-fired turbine.

Although this experimental locomotive provided much data for the U.P.'s mechanical department during its nineteen months of tests, it was an operational failure. The fly ash attack on the turbine blades was worse than expected, and the locomotive was found to be too troublesome maintenancewise. One of the operational problem areas was the critical control of fuel flow. It was very difficult to automatically control the proper flow of pulverized coal from the tender and prevent overspeed or "flame out" of the turbine power plant, especially during a change in power requirement. Much of this difficulty was overcome, however, by the U.P. Mechanical Engineering staff during the last months of operation.

On April 1, 1964, the coal turbine was renumbered 8080 to make room for a DD-35 diesel in the 70-84 series. Although still on the roster until April 1, 1968, the giant had been stored dead in Council Bluffs for almost four years. Retirement of the complete three-unit locomotive, together with the stock of special parts on hand, was approved on March 15, 1968. The 8080 cab unit was traded to EMD on an order of SD-45 diesels, while the 8080B was taken to the Omaha shops where the traction motors were salvaged and the remainder of the unit unceremoniously scrapped.

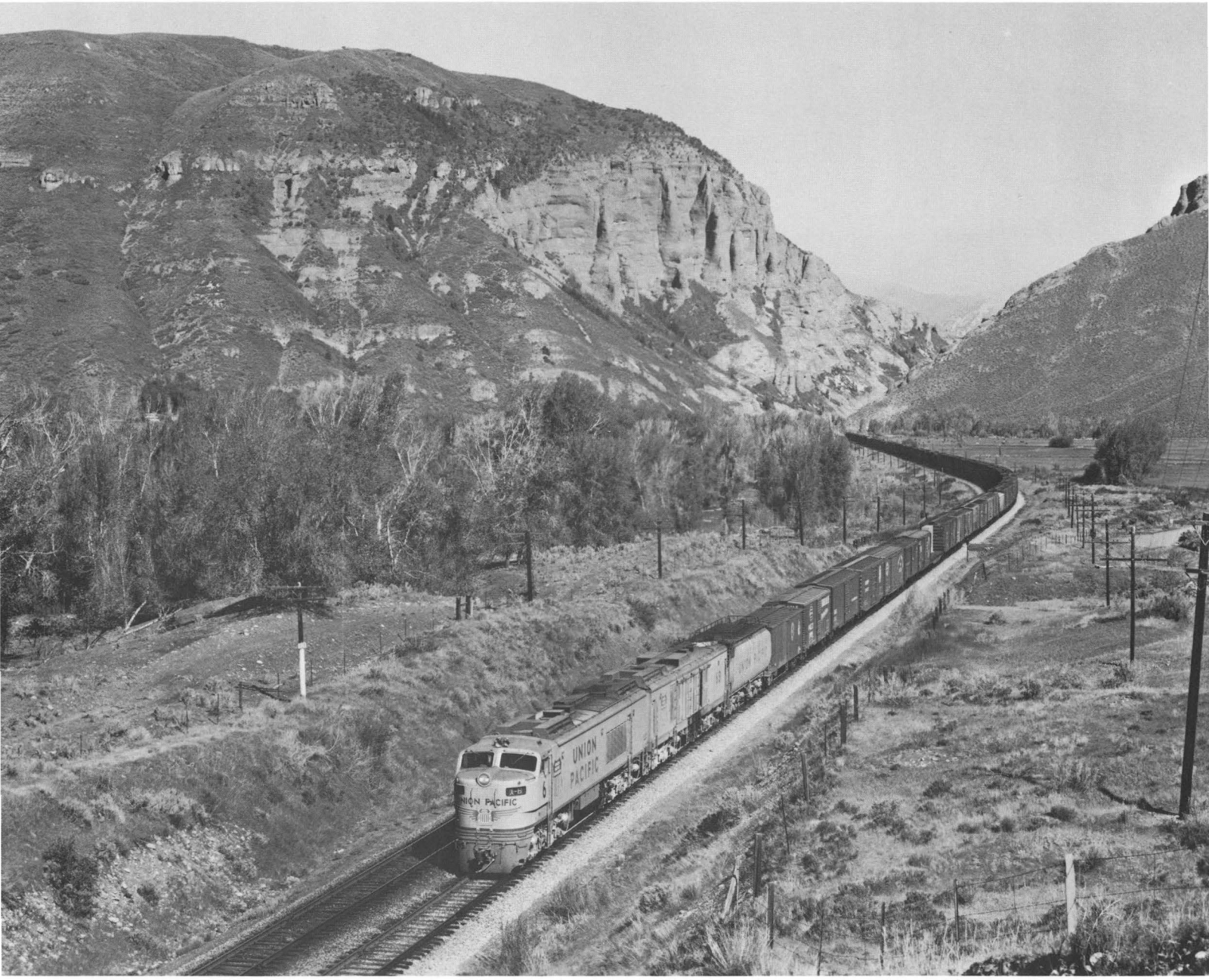
When reviewing the range of operation of the turbine locomotives on the Union Pacific, one realizes that #50, the original demonstrator, was the most widely traveled over the system. The steam turbines of 1939 made two round trips to Los Angeles and several trips to Denver from Omaha before being returned to Gen-

Lou Schmitz

The coal burning gas turbine locomotive was renumbered 8080 in April 1964. This photo was taken at Council Bluffs on May 17, 1964, just five days after its last revenue freight run.

eral Electric. In addition to the Council Bluffs to Ogden main stem, #50 ran over the South Central District to Los Angeles and over the Northwest District to Seattle. It also made trips to Denver from Cheyenne and to Kansas City from North Platte.

Numbers 51-60 were originally confined to the Ogden to Green River Sub Division, with an occasional trip to Rawlins. When delivered, #57 was assigned to the South Central District for testing with propane fuel, and normally was run between Los Angeles and Las Vegas. Its initial trip from Salt Lake City to Los Angeles was made May 24, 1953, handling a regular freight train. Diesel fuel was used, as the locomotive was to be converted to propane gas and receive the auxiliary tender at Los Angeles. When repaired in early 1954, the locomotive was modified back to heavy turbine oil and was returned to the Ogden pool for Wyoming Division service.



Union Pacific Railroad

The majestic beauty of the Wasatch range is evident in this 1959 photo of 8500 horsepower gas turbine electric #6 working upgrade near Henefer, Utah, with an eastbound extra. Country with names like Weber Canyon, Devils Slide, and Echo Canyon represent the mountain terrain that has been a continual battle for the railroad in moving tonnage across eastern Utah. After initial problems, the super turbines gained respect as real freight haulers.

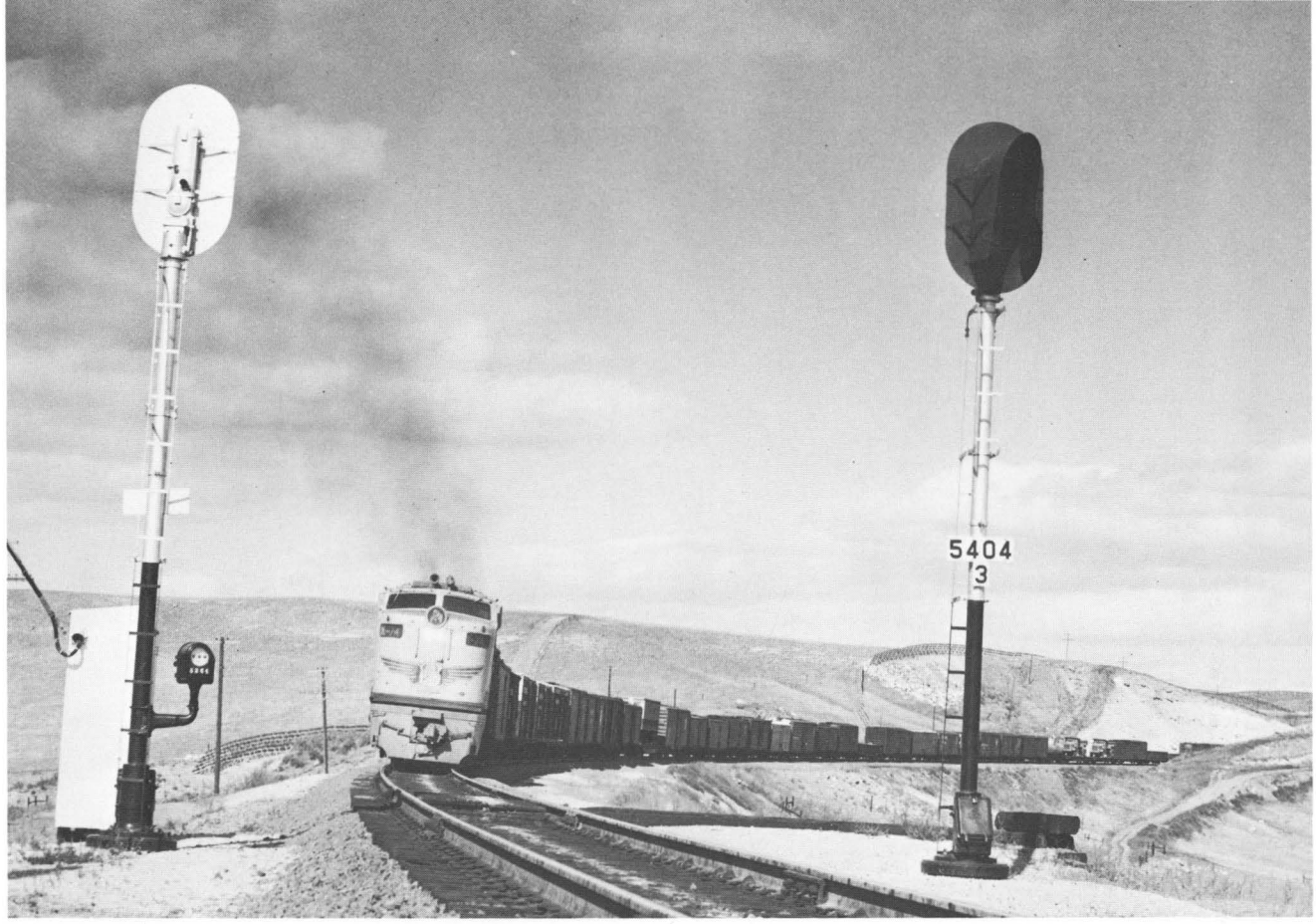
With the arrival of #61-75 in 1954, the turbines were making increasingly frequent trips eastward to Cheyenne. In late 1955, with the addition of the first auxiliary fuel tender, #61 began making test runs the full length of the Eastern District. As the other turbines were equipped with fuel tenders in 1956, their assignments covered the entire Council Bluffs to Ogden/Salt Lake City main line as needed. Number 67 also made two test trips to Kansas City from North Platte between May 24 and June 10, 1956, but the turbines never again saw service on the Kansas Division. Number 61, with two GP-9's, made a round trip test run to Los Angeles in mid-November 1958 during the turbine-diesel multi-unit trials.

Thos. R. Lee

The eastbound noon stock train is shown at Laramie, Wyoming, on August 20, 1957, with turbine 57 leading 82 cars of hotshot freight. The original propane burning experimental unit had long since been converted back to regular Bunker "C" fuel when this picture was taken.

Both photos by R. H. Kindig

April 12, 1952! The turbine era was only beginning, and the steam age was very much alive on the Union Pacific. The railfan who wanted to see both, and on the same train, had only to go to Weber Canyon. X-52 East has the help of "Challenger" 4-6-6-4 #3979 as the 98 car manifest crosses the Devils Gate Bridge east of Ogden, Utah, at 30 miles per hour. No doubt the two men of leisure, outside their box car home, are enjoying railroading at its best.



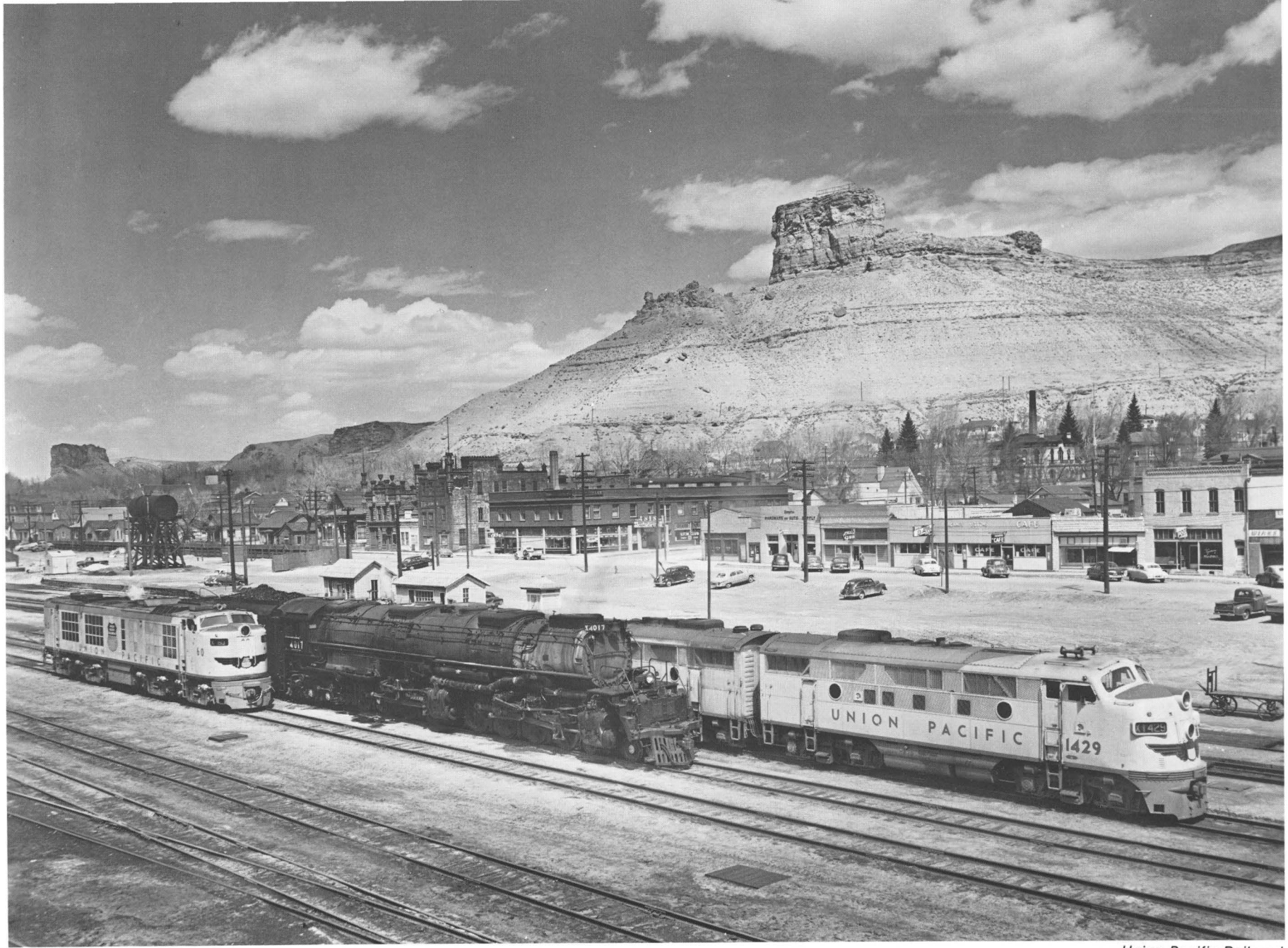
Donald Duke

No one needed to check the motor car train indicator on the left block signal to see X-74 West approaching Harriman, Wyoming, in the afternoon of September 13, 1956.

Likewise, the 1-30 series of 8500 horsepower turbines were originally assigned to the Eastern District's main stem. Several turbines of both classes were used to Los Angeles between April 27, 1962, and August 27, 1962, when multi-unit operation with new SD-24 diesels became common practice. At that time the turbine fuel oil was being furnished by the Richfield Oil Corp. and it was considered more economical to fuel the turbines at the point of origin and transport less of the fuel to the eastern servicing terminals. After removal from the South Central District, the gas turbines were to finish their service confined to the Eastern District's main line. None was to see Denver even though they were approved for use to the "Mile High City" and tonnage ratings were issued. Neither were any of the gas turbines ever officially recorded as being used on the Northwest District. Several of the 8500 horsepower turbines were to see Kansas City, but only as dead locomotives enroute to final scrapping destinations. The coal burning # 80 ran the majority of its tests on the east end of the Nebraska Division, occasionally making a trip to Cheyenne before returning east.

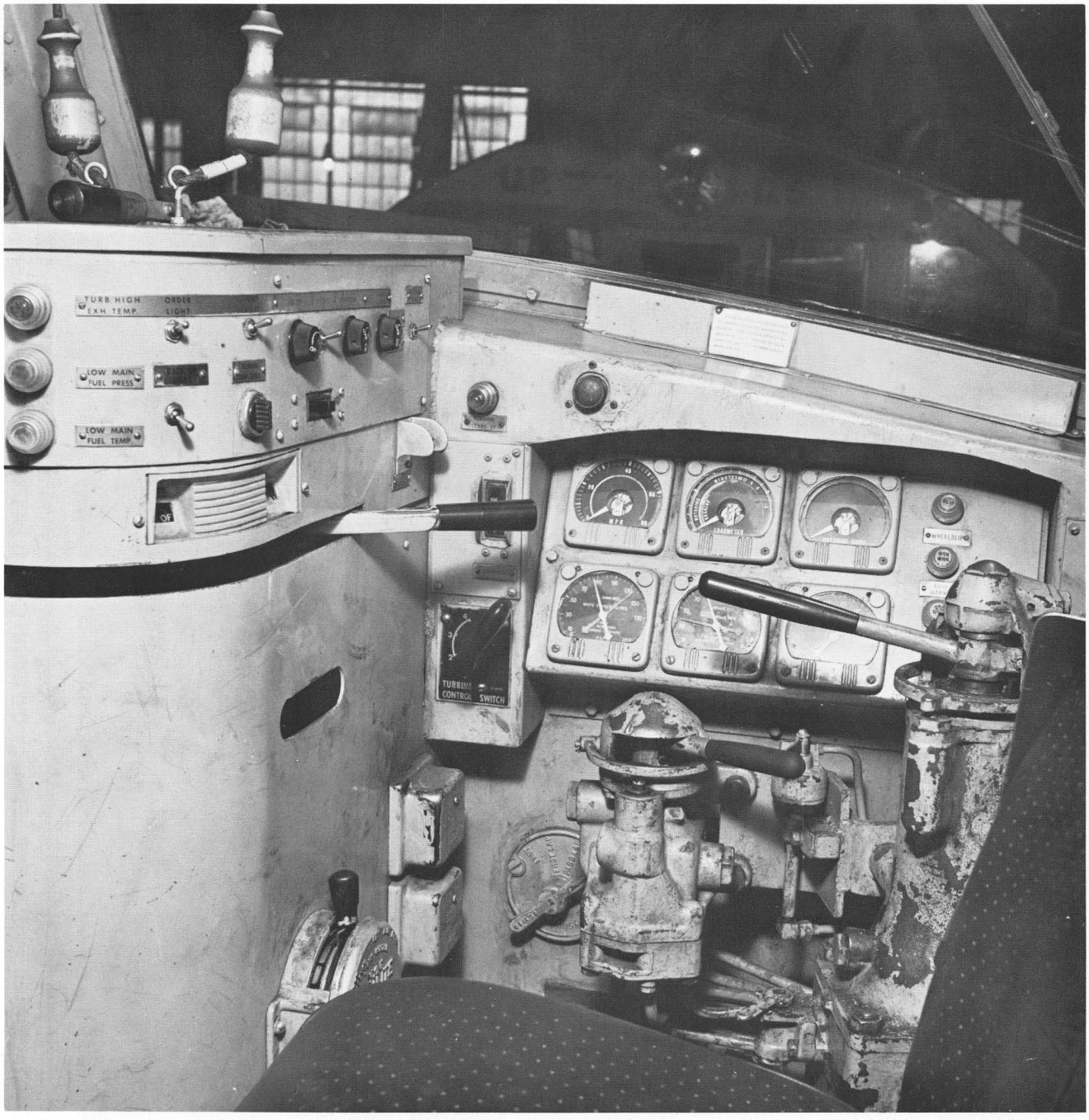
Maintenance wise, the turbines initially received most of their regular work at Green River. Later, major class repairs were made either at the new Salt Lake City diesel shop, completed in January 1955, or at the General Electric North Salt Lake City plant. With the extension of turbine assignments to include the Nebraska Division, some service and repair work was also performed at Omaha and Council Bluffs, which received a new diesel house in 1957. After the retirement of steam on the U.P. in 1959, the huge locomotive shops at Cheyenne also became the scene of some turbine repair.

When evaluating the performance and success of the gas turbine electric locomotives, the usual comparison is with the diesel locomotive of the day. On paper and in their early years of operation, they compared favorably. The turbine housed either 4500 horsepower or 8500 horsepower in one locomotive as compared to a multiple unit diesel. The gas turbine had only one large moving part, the shaft with the turbine buckets. Because of this, the turbine was mechanically much simpler than the diesel engine which has many moving parts such as pistons, connecting rods and valves. This had advantages in servicing and maintenance because of the fewer component parts. In terms of locomotive length, both classes of turbines produced over 50 horsepower per foot as compared with 30 horsepower for a diesel locomotive of the 1950's. The turbine power plant weighed less than half as much per horsepower as a locomotive type diesel engine of that period. Due to



Union Pacific Railroad

It was an interesting array of motive power that worked both ways out of Green River, Wyoming, in 1953. Gas turbine 60 was the last of the original order of 4500 horsepower "Big Blows", arriving in August of that year. The ten turbines were used between Ogden, Utah, and Green River, with an occasional trip to Rawlins. The world's largest steam locomotives, twenty-five 4-8-8-4 "Big Boys" like #4017, were working throughout the Wyoming Division as needed. The U.P. had dieselized the South Central and Northwest Districts and owned over 200 freight units like 1500 horsepower F-3 #1429. Coupled in three or four unit combinations, the diesels worked westward out of Green River to both districts.



Trains: *Wallace W. Abbey*

The engineer's operating station on a gas turbine was not much more complicated than on a diesel. There were only a few extra controls and warning lights and one extra meter — a notching guide which augmented the loadmeter in informing the engineer of the performance of the engine and the requirements of the train. The turbine control switch below the throttle was the only control needed to start the turbine prime mover itself. Another exception from the diesel was the 20-notch throttle (as compared with 8 on the diesel), which provided close control of power delivered to the traction motors. Power plant warning signals were grouped ahead of the fireman's station. Enginemen noted that the turbines moved fast in switching operations as compared with a diesel road engine.

the smooth rotating motion of the turbine and compressor, one of the outstanding features of gas turbine operation was the absence of the vibration so characteristic with the reciprocating diesel engine. In the case of the turbine, only the lubricating oil required cooling. This was about one-tenth the amount of cooling per horsepower required by a diesel engine.

By requiring less lubricants, cooling water, and supplies, the turbine locomotive accomplished additional savings in terminal servicing. It could be properly serviced in forty-five minutes, and on occasion was handled in twenty.

Not all aspects of operation with the turbine locomotive were positive, however. Its sole mission in life was high-speed, heavy-duty freight service. Unlike the diesel engine, which can be idled at minimum speed when power is not needed, the range of the gas turbine between idle and full power was very small; and this situation did not lend itself to economy in fuel consumption for some types of train service. To operate trains at slow speeds or light loads was to waste much of the turbine's energy.

The efficiency of any fuel-burning engine depends a great deal on the temperature at which the engine

Trains: Wallace W. Abbey

Servicing of a gas turbine at Green River, Wyoming, would begin at the time the eastbound train first arrived at the yard. Either a Union Pacific or General Electric maintenance engineer would board the locomotive and make a preliminary inspection while the train was moving through the yard. The unit was then cut off from the train and hostled to the servicing pit (shown above, turbine 56, March 1, 1953) where it was given a rapid but thorough inspection and cleaning. At the same time, diesel fuel was supplied, the steam generator was blown down and supplies were put on board. The locomotive would then be backed to the coal chute station (directly behind) where it was supplied with sand and heavy turbine fuel oil.

Trains: *Wallace W. Abbey*

Turbine 56 takes on sand and turbine fuel oil at Green River, Wyoming, on March 1, 1953. By requiring less lubricants, cooling water, and supplies, the turbine locomotive could be properly serviced in forty-five minutes, and on occasion was handled in twenty.

burns its fuel, the higher the temperature, the higher the efficiency. For this reason, the gas turbine, as designed, could never be as efficient as the diesel engine. The parts of a gas turbine that were exposed to the hot gases were continuously exposed to the heat when the turbine was running. Since no one was able to develop a satisfactory method for cooling such parts as the turbine buckets, it was necessary to limit the maximum temperature in a gas turbine to about 1400 degrees Fahrenheit as compared to 2500 degrees in the cooled diesel engine.

On extremely long downgrades or during delays where the locomotive would be standing for thirty minutes or longer, the turbine would sometimes be shut down so as to save fuel, and the auxiliary 250 horsepower or 850 horsepower diesel engine was used to operate the air compressors and other auxiliaries. The turbine was so tornadic by nature that it required about five minutes to completely shut down, and almost as long to get it wound up again. Because of the turbine's enormous thirst in comparison with a diesel, anything but a cheap fuel was prohibitive in cost. It was doomed to burn a low cost distillate "residual" oil, or what's left of crude oil after the quick-burning fuels have been extracted. This is commonly called No. 6 residual, or Bunker "C" oil, from its earlier use on seagoing tankers, but for turbine use it required additives and a desalting "wash" process which raised the cost some 20 cents a barrel over ordinary Bunker "C", the cheapest fuel oil available.

Through experience and extensive chemical and metallurgical research it was found that an unbalanced ratio of vanadium, calcium and sodium salts, which may be present in mine run residual fuel, were detrimental to combustion chambers, nozzles, turbine blades and other parts of the turbine.

Since the operating economy of a turbine was largely dependent upon its ability to use cheap fuel with a reasonable service life of component parts, the obvious solution was to provide a residual fuel of controlled specification by removing the excess salts and maintaining the proper ratio of the remaining affecting properties. Through the efforts of the Richfield Oil Corp. and General Electric, the problem was diminished to the extent it was no longer considered a major problem.

The economy of using one fuel over another is largely dependent upon the prevailing prices for the various types of fuel at a particular time. While the fuel cost for the gas turbine was comparable in the "fifties" with those of the diesel on a 1,000 gross ton mile basis, and considerably less than that for steam locomotives, the turbine's fuel costs did not compare as favorable in the next decade.

Despite its apparent brawn and power, the turbine turned out to be an expensive brute to maintain after several years' usage. As previously mentioned, there were definite problems with fuel pumps, nozzles, heating equipment, and turbine blade corrosion, inherent with the use of heavy fuel oil. Ingested dirt and dust, fouling air compressor stages and eroding power, became a problem without a total solution. Bigger air filters cut back efficiency too far, and other experi-

Trains: *Wallace W. Abbey*

After the turbine had been completely serviced, the final move was to the turntable where the locomotive was either turned for an immediate trip west to Ogden or else placed in the roundhouse. If additional work was required because of small equipment failure or leaks in the piping system, then these were corrected during the servicing operation. A great deal of attention was given to maintenance problems during the design of the 51-60 class locomotives. The main power plant, main gear-generator assembly and the other major assemblies could be removed and replaced without removal of other equipment or parts. The turbine prime mover or gear-generator unit could be removed from the locomotive and replaced by another unit and the equipment run without realignment.

ments were also unsuccessful. Whereas lower maintenance costs were essential to the overall economic success of the turbine, such costs contributed greatly to its final downfall. In sound operating practice, the turbines were eventually retired at the point where maintenance expense was far in excess of equivalent powered diesels.

By early 1958 some of the GTEL-4500 class locomotives were causing considerable trouble from engine failures, so several were stored during the business decline of that year. Again, during the business slump of early 1961 and with most of the new 8500 horsepower turbines in service, all of the smaller turbines were placed in storage. When #51-54 were retired in the spring of 1962, the trucks and other reusable parts were traded to General Electric on an order of eight U-25-B diesels. Most of the remaining stored turbines were eventually returned to service, seeing considerable usage in the summer and fall rush seasons of 1962 and 1963. The continual demand for more horsepower plus occasional engine failures dictated the common practice of multi-unit operation with diesels during their final years of operation after 1959.

As the remaining small turbines were gradually retired — the last four (#58, 59, 67, and 68) in June 1964 — the span bolsters, trucks, and miscellaneous reusable parts were again traded to General Electric, this time for use on an order of U-50 5000 horsepower "giant" diesels. The span bolsters from #51-54 were also utilized on this order. Most of the 4500 horsepower turbines had been in service less than ten years. Numbers 58 and 59 remained the longest, almost eleven years, while #71 and 75 had the shortest life, only nine years.

The same problems of major maintenance, inherent from several years usage, also caused retirement of some of the "Super Turbines" after a relatively short service life. As early as July 1966, #1 was in temporary storage at Cheyenne, and most of the giants were out of service in early 1968. Numbers 1-4 were the first to go, retired August 31, 1968. Like the others, they were traded or sold to General Electric, who would reuse the trucks on a new order of giant diesels for the Union Pacific, this time the 5000 horsepower U-50-C class.

By May 1, 1969, eight more of the 8500 horsepower giants, #19, 5, 15, 24, 25, 10, 9, and 17, had been removed from the roster. Next to go were #11, 12, 13, and 6, like the others eventually sold to General Electric. Many were retired when major repair work was required on the auxiliary diesel engine, rather than from turbine failure. Only thirteen remained on the roster December 1, 1969.

The future status of those locomotives was described in the following order dated December 6, 1969, issued from Omaha.

In order to provide an adequate number of locomotives to handle the 1970 summer and fall rush season of business, it has been decided to retain the following ten GTE locomotives in operating condition so they may be used at any time until the end of that year:

GTE 7-7B, 8-8B, 14-14B, 16-16B, 18-18B,
22-22B, 26-26B
28-28B (Diesel engine gear train bad order)
29-29B (Diesel engine requires work, consumes excessive lube oil)
30-30B

All ten of these locomotives must have necessary annual inspections completed in advance. Also, dynamic braking must be put in order; and all bad order air compressors must be overhauled.

Only three other GTE locomotives remain for storage.

These should be retired in the following order:

GTE 21-21B (Turbine bad order)
23-23B (Turbine very weak and will not properly handle heavy trains. Diesel engine in poor condition)
27-27B (Lube oil leaks around accessory drive. Diesel engine giving trouble)

Note: Should turbines on any of the ten locomotives listed above prove defective, Turbine 27-27B should be substituted. Therefore, do not strip this locomotive of parts unless absolutely necessary.

/s/ D. S. Neuhart
General Superintendent
Motive Power & Machinery

Several of the locomotives were given light repairs as needed. Official Union Pacific, General Electric, and I.C.C. records show no change in road numbers for any of the units prior to or after retirement. However, some interesting pairings of units did occur during 1970. With the diesel engine labeled bad order on turbine 28, the original turbine 20 control unit, retired November 30, 1969, was mated with the 28B at Cheyenne to form an operational locomotive should the turbines be returned to service. The unit was "renumbered" 28 by use of a decalcomania transfer; but the locomotive never saw service, and the respective units were officially retired and disposition made under their original road numbers. None the less, when R. H. Kindig and the author surveyed the dead line of retired turbines at Cheyenne on May 30, 1970, it was interesting to see two turbine control units in the same line numbered 28. An inspection of the turbine 28 "A" unit, presently at Intercontinental Engineering in North Kansas City, Missouri, would indicate that the unit is possibly the original 20 "A" unit. Since official records do not indicate this possible swap of cab units after retirement, this information is not included in the U.P. turbine roster

J. L. Ozment

Turbine 20 is eastbound out of Riverdale Yard at Ogden, Utah, in the late afternoon of November 1, 1969. The locomotive would be retired at the end of the month, although the 20 cab unit would be "renumbered" 28 in early 1970.

found elsewhere in the book. Likewise, turbine 12B, retired October 31, 1969, was mated with control unit 21 at Council Bluffs to form an operational locomotive, but it, too, was never used. After turbines 12 and 21 were sold to General Electric on January 7, 1971, they were shipped to the Erie plant paired with opposite mates.

Turbine "A" and "B" units of the same road number were assigned to run together permanently. Railroad records indicate, however, there were cases where different "A" and "B" unit road numbers were operated together.

On February 25, 1970, this additional message was issued from Omaha:

> Reference prior correspondence concerning status of the last ten (10) GE 8500-HP gas turbine locomotives which were previously scheduled to be traded in on our new 1970 GE U-50-C locomotives from General Electric Company.
>
> We are arranging for retirement of these ten remaining gas turbine electric locomotives; however, it must be understood by all concerned that it has now been decided that these ten locomotives will not be traded in at this time, or at any time in the foreseeable future, but must be stored in serviceable condition.
>
> When decision is made at some future time to dispose of these units, you will be notified in writing.
>
> /s/ D. S. Neuhart

At the time this message was issued, the gas turbine locomotives had already made their last revenue trips, in December 1969. A review of those last runs bears evidence that few of the turbines were still in regular service. Cheyenne was the assigned home terminal for the remaining "Big Blows" in late 1969, and December 3, 1969, appears to be the last day several were used in the "fleet" style of previous years. On December 13, 1969, #14 with diesels 3023, 178B left Cheyenne with a 99 car westbound "Salt Lake Manifest." On December 15, #26 went west with a 115 car drag while #14 was returning eastbound with an "OG" symbol of 97 cars. Taking the train on to North Platte the same day, #14 then returned on an X-West to Cheyenne where it was pulled from service. On December 18, 1969, X-7 West left Cheyenne with a 93 car drag, and #26 with diesels SP 9088, UP 3073, SP 8467, SP 8415 returned from Ogden with an "RV" symbol Roseville fruit train of 112 cars. Number 26, in shiny sparkling paint, was removed from the "RV" at Cheyenne and pulled from service. To turbine 7 fell the distinction of making the last runs as it returned to Cheyenne with diesel 727 on December 19, 1969, with a 93 car eastbound drag, continuing on to North Platte. It was the last turbine powered train to be run on the Wyoming Division. The next day #7 left North Platte for Cheyenne with SP diesels 8842 and 8881 on a westbound reefer drag. What appears to be the last turbine run was recorded December 26, 1969, when #7 took an eastbound to North Platte.

Through the years several of the turbines received minor superficial damage as a result of grade crossing accidents, etc. When retired, #24 had a scarred left side/nose panel that bore evidence of such an encounter.

The only turbine to be damaged extensively in a derailment was #8, in an action packed moment of misfortune. On the evening of June 26, 1965, at approximately 10:45 p.m., turbine 4 was eastbound at the west curve near Pine Bluffs, Wyoming. It hit a stalled automobile, pushing it into the west switch stand, causing

a split switch which in turn derailed several cars behind turbine 4. Unfortunately, some of the derailed cars fouled the westbound main track just as X-8 West approached. Unable to stop the speeding manifest in time, engineer Bill Weaver, with head brakeman Fritz Ley, rode the big turbine into the ditch where it came to rest buried in the ground about four feet and listing at a 45 degree angle. The locomotive was repaired and operated satisfactorily until retired in 1970. Presently, it is awaiting final disposition at the Intercontinental Engineering yard in North Kansas City. Turbine 55 also went on the ground in a derailment west of Rawlins between Red Desert and Tipon, Wyoming, during the mid-50's. It was undamaged, however, and continued operation after being rerailed.

Although the turbine locomotives are no longer in service, many of the tenders remain as fuel storage tenders at various terminals around the system. The tender from turbine 13 was repainted black and renumbered 907853 for use as an auxiliary fuel tender for the 8444, Union Pacific's last remaining operating steam locomotive.

Several of the 8500 horsepower locomotives also remain intact, except for tenders, and await final disposition. Turbines 8, 7, 29, 26, 28, and 18 were sold to Continental Leasing and are stored, in the numerical order listed, at Intercontinental Engineering Co. in North Kansas City, Missouri. The cab units of turbines 14 and 16 are being stored on U.P. property at Salt Lake City for present owner, G. E. Bean Co. of New Orleans.

When studying the turbine roster, one finds several items of interest. A period of nine months elapsed between the delivery of #56 and #57 as several changes were being made in design. All 25 of the 4500 horsepower turbines arrived in numerical sequence except for #63 which was delivered a week after #64.

The thirty 8500 horsepower turbines were ordered in two groups of fifteen each, and the serial numbers of each group are separated by a gap of numbers even though production remained constant in 1960 from the first group into the second. When originally ordered, the scheduled delivery of the first 8500 horsepower turbine was to be mid-1957. Initial problems delayed

that time frame for a year, which may explain why the serial numbers of the first seven are out of normal sequence. The mated units as delivered may not be the same as originally intended when built. The cab unit of #6 had the lowest serial number while turbine 4B had the lowest serial number among the "B" units. Turbine 2 had the lowest mated serial numbers and was built almost a year before delivered.

The remaining turbines, #8 through 30, had consecutive serial numbers and were delivered in sequence except for #20, which had lower serial numbers than #19 and arrived a month earlier than #19.

A span of eight months elasped between the delivery of #8 and #9, causing much speculation at the time that the initial problems encountered by the big turbines would cause cancellation of the remainder of the order. Those problems were corrected, and, after delivery of #9 in late November 1959, the remaining turbines were delivered at the rate of one each month.

Numbers 1 to 4 were taken to the Omaha shops in late 1958 to modify the propulsion circuitry system due to an unforeseen high speed transition problem.

Of the 8500 horsepower turbines, #7 remained in service the longest, almost eleven years, although at one time it was stored at Cheyenne, along with #24, for several months. Number 30 had the shortest service life, only eight and one-half years.

Most successful locomotive designs in history have had a service life of longer than ten years. The gas turbine enjoyed an auspicious beginning, and yet in only a decade's use for both classes, most were retired. To many observers the gas turbine locomotive has been labeled a failure, just as the steam turbine and coal

Thos. R. Lee

The development of the U.P.'s custom built 6600 horsepower DDA-40X "Centennial" diesels in 1969 helped bring to a close the turbine era. Four of the "World's Largest Diesels", #6911, 6904, 6922, 6939, are awaiting entry into the Cheyenne, Wyoming, yard on May 15, 1975, with a "CN" symbol eastbound of 156 cars.

turbine locomotives were — but were they really? Not if you consider all factors, for the Union Pacific had the horsepower performance and economy in the mid-50's that it took the diesel manufacturers ten years to equal or surpass with their turbocharged engines; and without the turbine to lead the way, the horsepower race of the "Giant" diesels might never have started. The 8500 horsepower turbines were delivered at a time when the typical diesel electric unit was rated at only 1750 horsepower, requiring four or five units on each train to meet the Union Pacific's operating practices. One turbine could replace several diesels, greatly simplifying operations. The development of higher horsepower, second-generation diesels, particularly the U.P.'s custom built 6600 horsepower DDA-40X "Centennial" locomotives, closed the gap.

Another factor that adversely affected further use of the turbines in later years was the changing fuel situation. By 1969 Bunker "C" oil, a one-time surplus of the petroleum industry, was no longer available as a low cost fuel. Advances in the petrochemical industry had found other uses for this oil, and the fuel hungry giants were no longer as economical to operate when burning regular diesel fuel, which was the fuel used during their last months of operation. So the remaining turbines were withdrawn from service and retired when it was no longer considered worthwhile to maintain the special service facilities that a handful of non-standard locomotives required. When the last turbines were removed from the roster March 1, 1970, the turbine era of modern locomotive power had come to an end.

At one time the Union Pacific had given consideration to ordering a third generation of turbines, but the road was unable to find a builder interested in providing a locomotive built to U.P.'s fuel specifications. Proposals were submitted by Pratt & Whitney for an aircraft type gas turbine power plant that could be installed in a locomotive car body, proposed to be built at the Omaha shops, but the project was never seriously considered.

Actually the possible success of gas turbine power had not gone unnoticed by General Electric's competitors, and one, the Westinghouse Electric Corporation of East Pittsburgh, Pennsylvania, had taken a hard look at the possibilities and entered the market with a test locomotive.

As a rule, Westinghouse had been a supplier rather than a builder in the locomotive field. Most of the Baldwin, Fairbanks-Morse, and Lima-Hamilton diesels built in the late 1940's were equipped with Westinghouse generators, traction motors and other electrical equipment. But in 1950 Westinghouse, as well as purchasing a controlling stock interest in the Baldwin Locomotive Works, was to make motive power headlines in its own right.

Westinghouse completed their experimental turbine in April 1950. The "Blue Goose", as it was nicknamed, was a 4000 horsepower heavy-duty passenger locomotive that fashioned a carbody appearance similar to the Baldwin Sharknose diesels. The 77' ll" long unit had three interesting features: two small single-shaft main turbine sets instead of one larger one as used on the GE unit, a waste heat boiler for passenger train heating that operated on the exhaust of the right-hand

turbine, and a new running gear arrangement. The carbody was carried on four four-wheel trucks without the usual span bolster, and all axles were powered and geared 57:22 for 100 mile-an-hour operation.

The 4000, as Westinghouse numbered it, weighed 460,000 lbs. and developed a starting tractive effort and continuous rating comparably favorable to a two-unit EMD or Alco passenger diesel.

Painted blue and gray with an orange-striped nose, the "Blue Goose" commenced tests on the near-by Union Railroad, working as a freight train helper on a diet of diesel distillate. Later, as a result of overheating, the turbine suffered a blade failure while running tests on the Bessemer & Lake Erie with ore trains.

When rebuilt, the 4000 was fired on Bunker "C" fuel oil and returned to the road — this time for ten weeks of tests on the Pittsburg & Lake Erie, where it handled up to 6,000 tons in freight service. Once again, the locomotive was sent back to the East Pittsburgh Works for design changes and replacement turbines.

Finally, the locomotive was ready for road-testing in the heavy-duty passenger service for which it was designed. Starting in February 1952, the "Goose" ran a six-week test on the Pennsylvania Railroad, hauling heavy mail and express trains at the high speeds it was capable of. Performance was good. Number 4000 handled up to 29 cars on the Harrisburg-Altoona run and once raced an 1800 ton express train across the division on the "Broadway Limited" schedule.

Next stop in the turbine's 1952 travels was in the midwest — Parsons, Kansas, where the "Goose" ran 26,000 miles of tests on the Missouri-Kansas-Texas Railway between Denison, Texas, and Parsons with the "Bluebonnet" and the "Katy Flyer." In performance the turbine more than held its own in assignments usually handled by 4,000 or 4,500 horsepower diesels. It was somewhat sluggish in acceleration, but its greater kick at speeds above 40 miles an hour was noticeable.

After its summer tests on the Katy ended, #4000 was stripped down in the Parsons shop for a minute examination, and the technicians again gave it a clean bill of health. The locomotive was operating satisfactorily from both the turbine performance and locomotive tracking standpoints.

In September 1952, the "Goose" began tests on the Chicago & North Western Railroad, pulling passenger "Limiteds" between Chicago and Elroy, Wisconsin. It continued to confirm the Westinghouse belief in the practicality of gas turbine power for locomotive use. Unfortunately, however, the locomotive became a reality during the time when the management at Westinghouse was questioning the viability of continuing in the railroad locomotive business. When the unit returned from the C & NW, the tests were abandoned and the "Blue Goose" was dismantled in 1953. The first six locomotives of U.P.'s production gas turbine electric's were already in service when the demise of #4000 came about. In a sense it had become an orphan of Westinghouse rather than a "failure."

Three other ventures into the development of a turbine locomotive as a power source had met, for one reason or another, with ultimate failure. Around 1940, the Pennsylvania Railroad, the Baldwin Locomotive Works, and the Westinghouse Electric Corporation undertook the design of the first geared direct-drive steam turbine locomotive. By late 1941, engineering drawings were completed, but America's entry into World War II temporarily shelved construction. The War Production Board did give approval to the project later on, however, and Pennsylvania Railroad Class S-2 #6200 was completed in 1944.

The locomotive looked much like a conventional steam locomotive except it mounted two turbines, one on each side over the center pairs of drivers, in place of the usual cylinders and valve gear. It had a 6-8-6 wheel arrangement, with turbines connected by gears to the center driving axles. Since a turbine can operate in only one direction, two turbines were required, a 6500 horsepower forward turbine and a 1500 horsepower reverse unit.

The forward turbine remained connected to the drivers at all times, while the reverse turbine could be disengaged by a clutch.

The boiler of #6200 was a big conventional Belpaire fire-tube unit, operating at 310 pounds pressure with a maximum steam temperature of 750 degrees. A high-pressure boiler plus condenser would have undoubtedly increased efficiency, but it was considered inadvisable at the time to attempt two major developments simultaneously; so the builder's efforts were confined to the turbine.

The locomotive was designed for heavy-duty high-speed passenger service, and initial road trials, between Chicago and Crestline, Ohio, were announced as quite successful. Number 6200 obviously had the ability to roll heavy limiteds at high speeds; on a special run, the locomotive handled 17 heavyweight cars at 105 miles per hour. At speeds of 70 miles per hour or more, #6200 proved to be more efficient than the usual reciprocating steam locomotive. Less impressive, however, was the fact that at lower speeds the locomotive consumed too much steam; and in time, the S-2 managed to spend more time in the road's Ft. Wayne and Crestline shops than in service. Number 6200 was last used in May 1949 and eventually scrapped.

The next American experiment with steam turbine locomotives was three coal burning locomotives built in 1947 by the Baldwin Locomotive Works for the Chesapeake and Ohio Railroad. These locomotives combined the electrical transmission idea of the Union Pacific's 1939 steam turbines with the conventional boiler design

Chessie System Archives

The Chesapeake and Ohio received three coal burning steam turbine electric locomotives, rated at 6,000 horsepower. The first, #500, is shown in early road trials during the winter of 1947-48.

Chessie System Archives

The steam turbines were originally built for use on the "Chessie", a much publicized new streamliner that was to run between Washington and Cincinnati. The "Chessie", as pictured above with dome cars and turbine #502, never made the time table, however. Many of the streamlined passenger cars were sold to other railroads, and the steam turbines were used less than three years in regular passenger service.

of the Pennsylvania S-2. The three locomotives, numbered 500 to 502, had an unorthodox 4-8-0-4-8-4 wheel arrangement with leading, intermediate, and trailing four-wheel trucks and two eight-wheel nonarticulated wheel bases for drivers. The entire locomotive above the wheels was encased in a streamlined hood. They were unusual in design also because the boiler firebox was toward the front of the locomotive, and the soft coal bunker, holding 29¼ tons, was carried in the nose of the locomotive. The trailing tender carried only water. Overall length of the locomotive with tender was 154 feet.

Eight traction motors were mounted on the driving axles. These obtained their power from two double-armature direct current generators driven by the steam turbines, which developed a rated 6000 horsepower at 6000 RPM.

The orange and aluminum streamlined locomotives were originally built for passenger service between Washington and Cincinnati, a territory where long, severe grades are encountered in the Allegheny mountains and where fast speeds are demanded on the Cincinnati Division. At the time, C & O was contemplating the addition of a much publicized streamliner, named the "Chessie", to this route. The "Chessie" never made the time table, however, and the three steam turbines were assigned to existing passenger schedules over this territory.

The "500's" were patiently wet-nursed during their experimental trials, for excessive coal consumption and poor exhaust draft were severe problems from the start. Even with these bugs reportedly corrected in subsequent shoppings, the big units proved to be something considerably less than 6000 horsepower locomo-

tives, and in actual operation performed about equal to other engines rated at 4500 horsepower. Total locomotive weight of 411½ tons was excessive when compared to the horsepower output. The stillborn "Chessie" steam turbines failed to become the new mode of motive power as predicted by Board Chairman Robert R. Young. They were used less than three years before being removed from service in 1950 and sold for scrap a year later.

The third venture was a joint creation that took five years to finish before a coal-burning steam-turbine-electric was delivered to the Norfolk and Western Railway in May 1954. Babcock & Wilcox built the watertube boiler. Westinghouse made the turbine, generators, and traction motors; and Baldwin-Lima-Hamilton assembled the locomotive at its Eddystone plant.

N & W #2300 was a freight locomotive rated at 4500 horsepower. It used a 6-6-6-6 style wheel arrangement, with all trucks motorized. The big unit was similar in design to the Chesapeake and Ohio's "Chessie" 500's except it employed a 900 degree steam, 600 pound high pressure watertube boiler, that was expected to cut fuel costs in half.

The coal hopper, holding 20 tons, was in the nose of the streamlined carbody, followed by the engineer's cab, boiler, turbine, two-unit direct current generator, electric controls, and dynamic braking equipment. The fire burned on a traveling grate with continuous ash removal, while automatic controls maintained full boiler pressure as the load fluctuated between idling and full load. The unit did not have a condenser.

With a 60 mph maximum speed gear ratio and 42" wheels, the locomotive had a starting tractive effort of

Norfolk and Western Railway

Norfolk and Western's steam turbine #2300 ran road trials on the rugged Radford and Pocahontas mountain divisions in the late summer of 1954. The coal burning turbine developed 175,000 lbs. starting tractive effort and bested the N & W's large steam locomotives in tonnage rating.

Norfolk and Western Railway

Nicknamed "Jawn Henry", in tribute to the huge man of legend, Norfolk & Western's steam turbine electric #2300 was indeed big. The 4500 horsepower locomotive was 161 feet, 1½ inches long and weighed 586 tons fully loaded.

175,000 lbs. and a continuous rating of 144,000 lbs. at 9 miles per hour. A 22,000 gallon tank tender was used for water only.

Dubbed "Jawn Henry," in tribute to the huge man of legend, #2300's job was to lick the rising costs that were threatening dieselization of the all-steam, coal-burning Norfolk & Western.

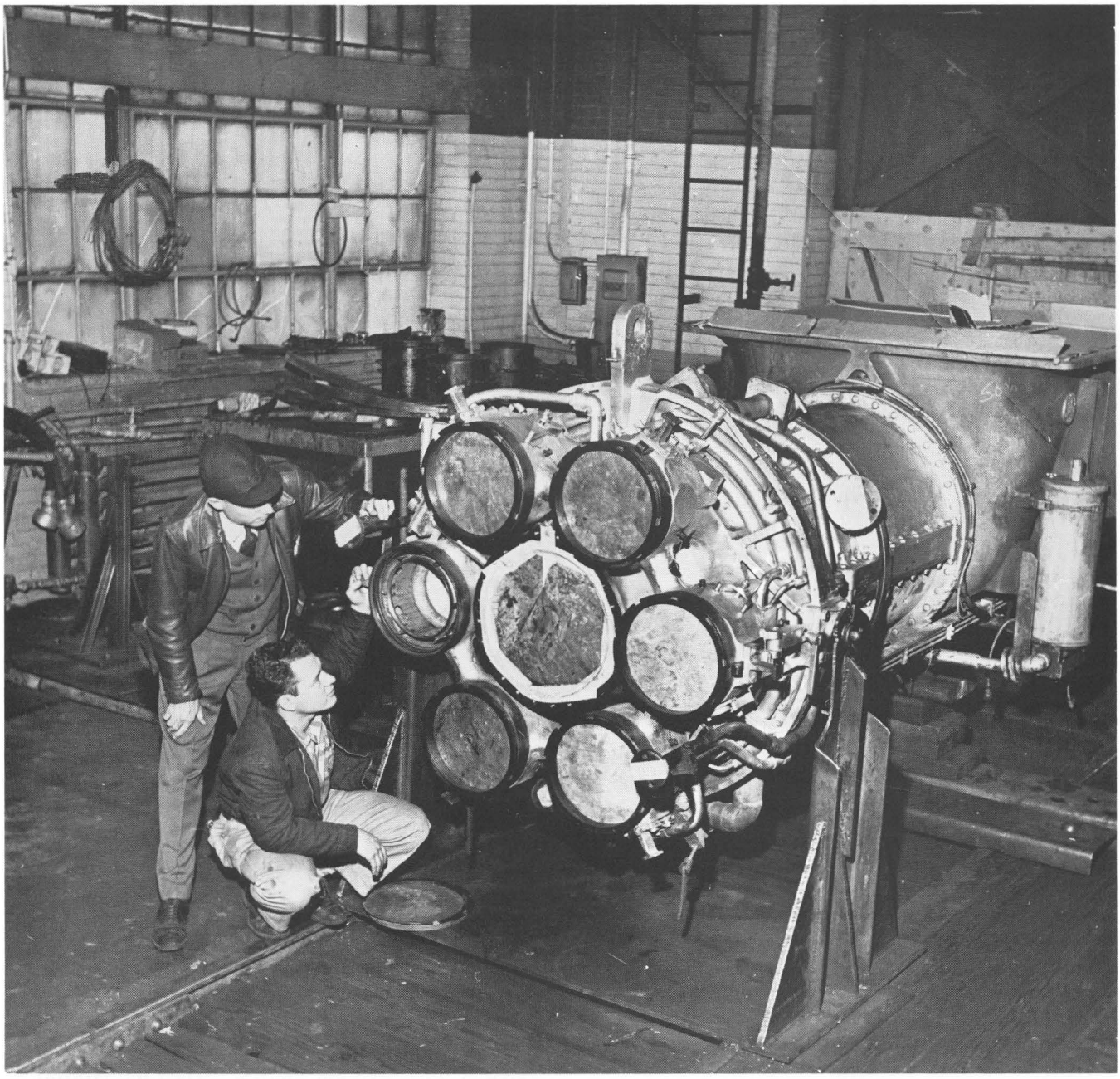
Road trials were made on the rugged Radford and Pocahontas mountain divisions and on the rolling Kenova District of the Scioto Division between July 19, 1954, and October 2, 1954.

The turbine was compared with the N & W's powerful Y6b Class 2-8-8-2 mallet on the mountain divisions. Number 2300 bested the Y6b in tonnage rating and fuel savings, but at a decrease in speed. When "Jawn Henry" was operated at speeds above 41.5 miles per hour, the drawbar horsepower output of the locomotive unexpectedly decreased.

The big turbine proved, in time, capable of doing the same work on 30 per cent less coal than conventional steam locomotives, but the unit was soon toting an auxiliary water car of 16,000 gallons behind its regular tender to help satisfy a thirsty boiler. Chronic maintenance on controls, feedwater, turbine, and electric components also kept the locomotive inside the Roanoke shops or close at home in helper service on coal trains over the Blue Ridge Mountains. Number 2300 had additional drawbacks of being extremely long, 161' 1½", and heavy, 586 tons loaded, for a locomotive rated at only 4500 horsepower. When the Norfolk & Western began the move toward dieselization, "Jawn Henry" was retired, December 31, 1957.

Another venture, seldom mentioned, was a 3750 horsepower gas turbine locomotive, to be built by the Baldwin Locomotive Works in the late 1940's for the Santa Fe Railway. Though seriously planned, the intended unit never progressed beyond the point of engineering drawings.

Recent use of turbine engines for railroad power include six 2,280 horsepower Turboliners, built in France, and used by Amtrak between Chicago and St. Louis. Three similar Turbo-Trains rated at 2,000 horsepower have been built by United Aircraft for Amtrak, and these trains are helping in the hard battle to rebuild a viable passenger system for the American railroad traveler.



Trains: *Wallace W. Abbey*

Part of a spare gas turbine prime mover is shown in this photo taken March 1, 1953, in the back shop at Green River, Wyoming. Richard E. Prince, Supervisor of Oil, Gas and Electric Mobile Power (standing) and John E. Brill, Service Engineer of General Electric, are inspecting one of the six combustion chambers of the 4500 horsepower turbine. Air entered the turbine at top right and was compressed in the center of the unit, then fed with the fuel into the combustion chambers, where it was ignited. Not shown is the other end of the turbine, the turbine rotors and exhaust end, which had been detached for maintenance purposes.

In early 1953, former President Harry S. Truman and his family were traveling to San Francisco by train in the company of W. Averell Harriman, U.P. Board Chairman from the mid-thirties through World War II. During the layover between trains at Green River, Harriman, enthused about the turbine locomotive, took Mr. Truman on a tour of the shop area; and Richard Prince explained the inner workings of the turbine to the unexpected visitors.

Green River roundhouse foreman Worth A. Fox approached Mr. Truman and said, "I've always wanted to shake the hand of President Harry S. Truman." To which Mr. Truman replied, "I do not know why you would want to shake my hand, but I will be mighty glad to shake yours."

Union Pacific Railroad

The gas turbine story would not have progressed past the original #50 had not it received the blessing of Arthur E. Stoddard and David S. Neuhart, who truly shaped motive power history.

The Union Pacific turbine story would not be complete without mentioning the men who advocated their very existence, and helped shape the personality of the unique locomotives. Union Pacific has traditionally been a hard-driving, man-killing outfit. It shoved its track west through Indian attacks and financial scandals and unceremoniously hanged train robbers on the spot. Railroading is a tough business, and to keep a road in the black takes brains and, occasionally, two-fisted management. William M. "Bull" Jeffers, President of the road from 1937 to 1946, was an example of that type for he sometimes punched employees in the jaw and frequently fired them. Jeffers thought it kept a man humping to be demoted occasionally, or to be fired suddenly and maybe rehired later. He personally fired an official named Arthur E. Stoddard five times, but brought him back each time.

Art Stoddard started railroading at the age of 11 as a 25¢-a-day waterboy, when trains ran on steam, sweat, and tobacco-juice. He spent 33 years building his way to the top spot and became U.P.'s President in March 1949. The promotion came after Stoddard, without orders, had left his Omaha office for Cheyenne to personally take command of U.P.'s fight against a blizzard which had buried tracks and paralyzed the railroad west of Laramie. It was the blizzard of a lifetime in those parts. The temperature was 51 below, and the frozen drifts were 30 feet high. Bulldozers and rotary plows stuck fast, and the tracks were finally cleared by using dynamite to break the drifts.

Stoddard was still in Cheyenne, mopping up, when word came of his promotion. In his sixteen years as U.P.'s boss, he gained the reputation as a tough, hard-nosed, and hard-working executive. He expected the utmost of his subordinates, and continually pushed for a fleet of modern and powerful locomotives. The experimental gas turbine, # 50, was rolling over U.P. rails less than four months after he assumed command, and all 55 production model gas turbine electrics were purchased during his tenure.

When the Union Pacific hired a shy youngster named David S. Neuhart in June 1918 as a coach cleaner at Salt Lake City, nobody dreamed he would eventually become General Superintendent of Motive

***Trains:** Wallace W. Abbey*

Richard E. Prince, presently Engineer of Motive Power Design at Omaha, was at Green River, Wyoming, for fifteen years as a member of the turbine staff. He's shown in this photo inspecting the combustion chambers of a 4500 horsepower turbine prime mover.

Power and Machinery for the entire system.

Neuhart assumed Motive Power control on April 1, 1949, a month after Stoddard became President. As Motive Power's top man, he strove for the highest possible horsepower in the least number of units and thus made the U.P. famous for its gigantic diesels and gas turbines.

Union Pacific people are proud of the tradition that, in some respects, their road is the biggest, the best, the greatest. Their motive power men have long been accustomed to big engines, a fine plant, and plenty of traffic. Such a carrier could well afford to be inventive and individualistic, as indeed it was during the Neuhart era and even before.

Otto Jabelman, a transportation giant in his own right, had given the road the 4-6-6-4 "Challengers," the huge 800 Class Northern types, and finally the world largest 4-8-8-4 "Big Boy."

Dave Neuhart grew up around these steam monsters and they must have helped shape his ideas. From the very first, Union Pacific seemed never to be satisfied with the stock diesels of the day. Omaha was always willing to try something new and bigger. So from a small M-10000 "City of Salina" Streamliner, born of the depression, to the mammoth DDA-40X "Centennial" diesel units of 1969, the road's major achievements in diesel progress were made during Neuhart's 1949-'70 term of office. Except for the experimental steam turbines of 1939, the Neuhart era was also the turbine era on the Union Pacific. Without his blessing, the gas turbine would never have progressed beyond the original #50. Each of the three classes of GTEL's were individual in design, and Neuhart's influence helped shape those differences.

Dave Neuhart has been called "A Giant Among Motive Power Men," a fitting tribute, for among his achievements he brought forth both the world's most powerful locomotive, in the 8500 horsepower gas turbine, and the world's largest and most powerful diesel locomotives, which helped spell retirement for those turbines. His 6900 Class "Centennial" diesel was the culmination of a great career — his "Big Boy" of another era.

Neuhart had on his staff many qualified men who became turbine specialists and were the field men responsible for the over-the-road history the turbines were to make. Leonard F. Zeiler, presently Engineer of Diesel Locomotive Design at Cheyenne, was a member of Neuhart's original turbine staff and worked with the turbines until 1970. Ben V. Johnson of Los Angeles was head, until 1956, of the original four-man turbine staff, which also included Ross C. Hill and F. B. Lubischer.

Richard E. Prince, presently Engineer of Motive Power Design at Omaha, joined the staff in November 1952, as a replacement for Mr. Lubischer, and spent fifteen years at Green River, Wyoming. Other motive power people who were later involved in the day to day operation of the gas turbines were J. E. Christopherson, M. G. Marler, M. R. Meade, W. W. Turner, Jr., Elmer Miers, Al Morck, F. D. Bruner, and Marion A. Scott. John P. McGlynn served as training instructor for the maintenance personnel.

General Electric also had an oil-fired turbine staff which spent much time on the U.P. William Appes, John E. Brill, Earl Hanson, Al Frink, Newman MacDonald, C. J. Kline, Bob Grunwald, and William Staub were GE service engineers who worked side by side with the Union Pacific turbine staff.

Harold Rees, retired Chief Mechanical Engineer, was in charge of the coal burning gas turbine project. Other engineering personnel heavily involved with the experimental Omaha built locomotive included H. Ogren, C. J. Adams, F. M. Christensen, F. V. Lubischer, J. E. Seitz, C. L. Johnson, and E. M. Marshall. These engineers were responsible for the design and arrangement of components and equipment, machinery arrangements and piping, power wiring and electrical controls. They also took part in the supervision of construction and the testing of the locomotive, both at the Omaha shops and on the road. Other engineering personnel who helped on the project included W. O. Carmichael, D. L. Peterson, W. D. Turley, Marion A. Scott, and M. R. Mead.

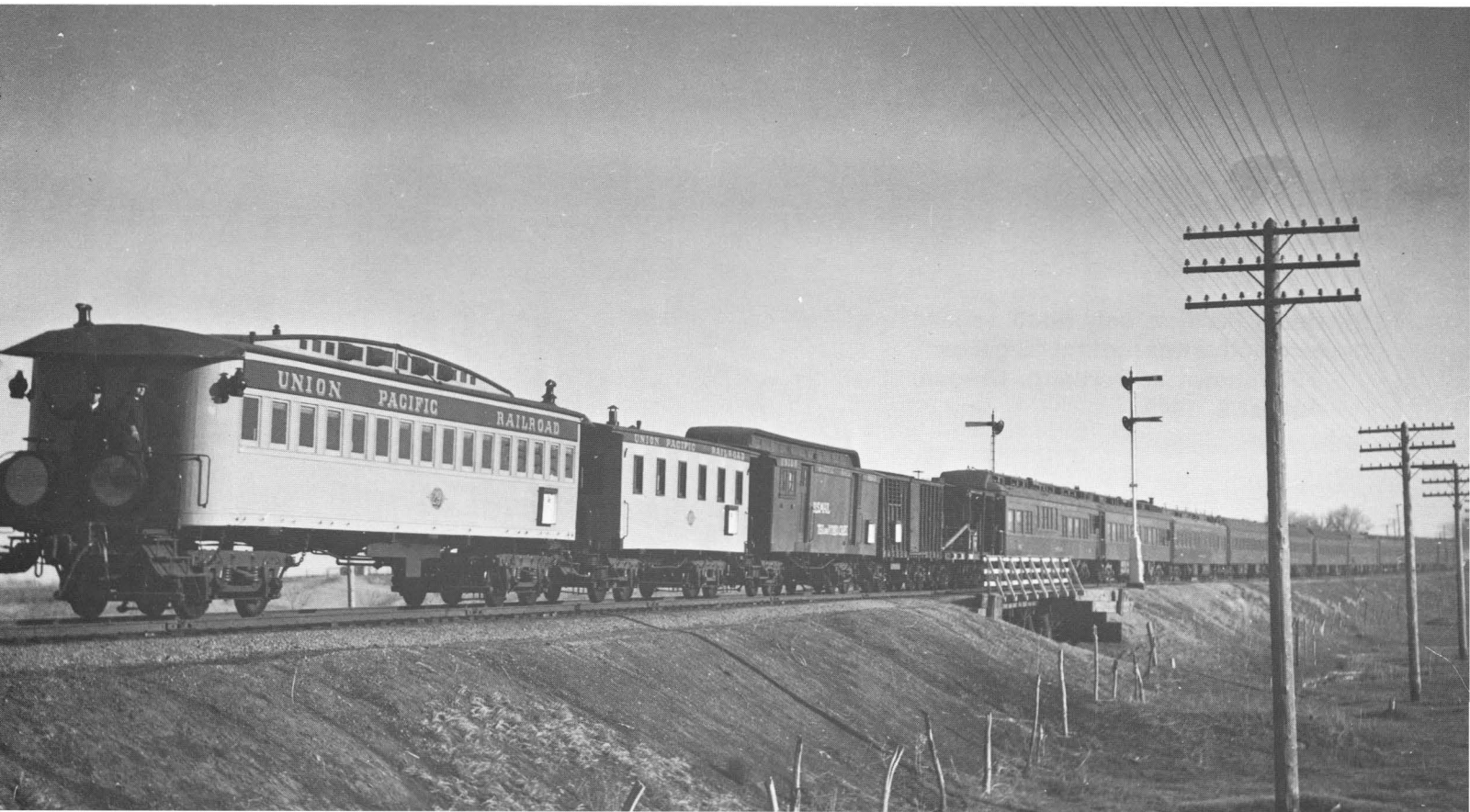
No doubt other deserving people, whose names were not uncovered by the author, also worked with the turbines and should have been mentioned. All of these Union Pacific and General Electric people should be noted, for their expertise and dedicated work has been too little recognized, and was instrumental in the success the oil-fired turbines had on the Union Pacific.

When reminiscing with U.P. employees, who knew the gas turbines and believed in them, one finds a deep admiration for the locomotives that adds to their uniqueness. "They could outpull anything on the railroad when mechanically sound," is a comment frequently heard from motive power men and engine crews alike who had felt the pulse of turbine power first hand. Even in their passing, the turbines are not forgotten by these people.

Whereas the experimental steam turbines of 1939 and the coal burning turbine of 1962 were classified as failures, the fifty-five production model gas turbine electric locomotives were not. They had produced an impressive record and been a vital part of moving a tidal wave of traffic on the historic railroad. As a transcontinental railroad, the Union Pacific had gained untold experience in an area of motive power that may one day again find itself as a locomotive power source for freight service. Union Pacific had again been the leader in a unique chapter of motive power development — the 1952-1969 turbine era.

Both photos by R. H. Kindig

Virginia & Truckee 4-4-0 #18, repainted as U.P. #58, is proudly leading the way with steam turbines 1 and 2 as the unusual locomotive combination powers a special exhibition train through Lucerne, Colorado, on April 26, 1939. Rolling 60 miles per hour, the 15 car train is enroute to Denver on the third day of a three week nationwide barnstorming tour advertising Cecil B. DeMille's movie, "Union Pacific."



Virginia & Truckee 18, disguised as U.P. 58, with steam turbines #1 and 2 moves the Cecil B. DeMille special exhibition train south of La Salle, Colorado, at 50 miles per hour in the late afternoon of April 26, 1939.

R. H. Kindig

Steam turbine electric 2 is at Denver May 27, 1939. A boiler malfunction caused the unit to be replaced at Sterling, Colorado, on its next trip east with train number 12.

R. H. Kindig

Union Pacific's only double-ended locomotive was the first "Big Blow", #50, shown at Portland, Oregon, August 9, 1949.

Don H. Roberts photo, R. H. Kindig collection

J. A. Rutherglen Collection

The straw hat was prevalent among the onlookers at the North Platte, Nebraska, depot on October 20, 1949, when the X-50 arrived for a crew change. The blue flags will soon come down, and a "highball" will start the turbine westward on another test run.

J. A. Rutherglen Collection

The south yard limit at Seattle, Washington, is the site of the X-50 as it moves the six car tour train, including four business cars, toward Union Station. The train is on Milwaukee Road rail in electrified territory, in August 1949.

Donald Duke

Gas turbine 50 is pictured at Los Angeles, September 30, 1949. This view is from the "rear end."

J. A. Rutherglen Collection

In the first weeks of test operation the heavyweight passenger cars were a common sight behind #50. This photo was taken on a hot August 4, 1949, in the Blue Mountains of eastern Oregon, as brake shoe smoke partly obscures the freight portion of the train.

Trains: Wallace W. Abbey

The first production-model gas turbine electric locomotive, #51, stands in the roundhouse at Green River, Wyoming, March 1, 1953, for regular maintenance. The turbines were repaired in a section of the roundhouse until the new diesel and turbine shop was completed at Salt Lake City.

Emil Albrecht

As a young "railfan" points the way out of town, turbine 51 moves past the elevator at Ogden, Utah, with an eastbound manifest on October 2, 1955. Note the change in appearance of the locomotive with the removal of chrome side grills and the addition of the roof air intake.

Union Pacific Railroad

Hanging high at Union Pacific's Salt Lake City diesel and turbine shop is #51 while #58 silently rests below. Purpose of the lift on February 9, 1955, was to test the new 270-ton Whiting crane installed in the shop. At the time, the crane was believed to be the largest railroad traveling crane west of the Mississippi. It was the first time that one of the huge 4500 horsepower locomotives, fully loaded, had been lifted.

Richard Steinheimer—Everett L. DeGolyer Library

"Wow! Those were great days!" Indeed they were, Richard, for 1953 saw steam and turbine working side by side. The 3802, one of Union Pacific's 105 4-6-6-4 "Challenger" steamers is backing down at Green River, Wyoming, for a westbound freight that will soon be heading up the old Oregon Short Line toward Pocatello, Idaho. Turbine 56 has just handled an eastbound up Echo Canyon from Ogden, Utah, and is on the service pit for regular cleaning and maintenance.

Turbine 51 had yet to have the air intake converted to the roof when this photo was taken October 11, 1953, at Green River, Wyoming.

R. H. Kindig photo, Paul R. McDonald collection

Turbine 52 was taking on fuel oil at Ogden, Utah, on April 12, 1952, when Dick Kindig caught the brand new locomotive. Only four days before, the unit had emerged from the Omaha shops with EMD chrome grills as an experiment toward protecting the air intake filters on the sides.

R. H. Kindig photo, Paul R. McDonald collection

Turbine 53 is at Ogden, Utah, on March 23, 1953. The experimental air intake unit has been installed in the roof, and the appearance of the locomotive is considerably different from its sisters. Photos of #53 with the other styles of air intake housings appear elsewhere in the book.

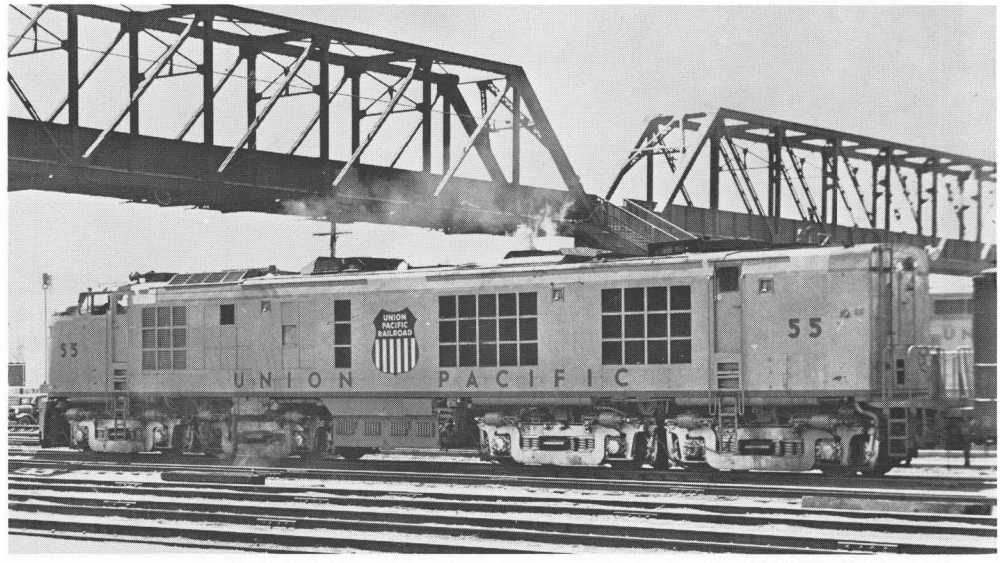
Don H. Roberts photo, Paul R. McDonald collection

Art Stensvad, Stan Kistler Collection

(Above) Turbine 54 is shown as delivered at Council Bluffs, Iowa, on May 31, 1952. The locomotive had yet to enter the Omaha shops for customizing. Note the GE sticker on the side cab window, the protective covering over the side air intakes, and the absence of the large U.P. shield decal. (Right) The same locomotive is shown at Ogden, Utah, on March 23, 1953.

Paul R. McDonald Collection

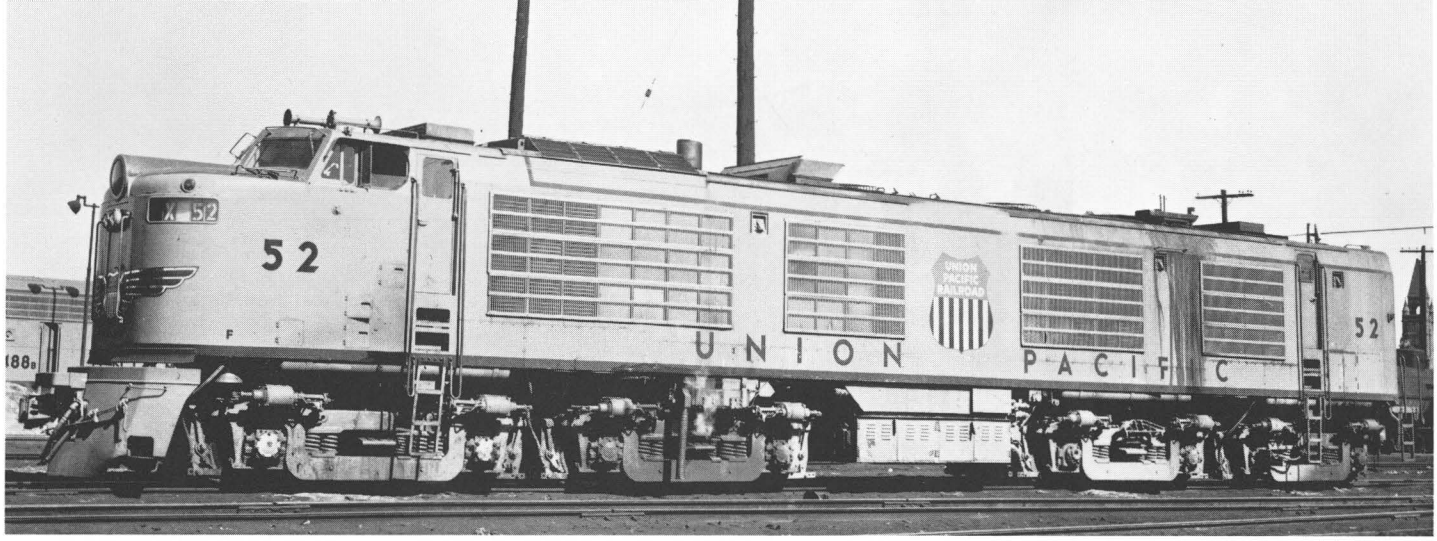
Turbine 55 enters the yard at Green River, Wyoming, with an eastbound on June 9, 1955.



J. L. Ozment

Turbine 56 is also pictured at Ogden, Utah, October 26, 1952. With the chrome side grills, the carbody GTE units displayed a striking appearance. Built in August 1952, #56 was the last of the six gas turbines to be received in 1952.

Paul R. McDonald Collection



Stan Kistler

Turbine 52 was pointed west at Cheyenne on the morning of October 1, 1954. Only #75 of the 4500 horsepower turbines remained to be delivered on that date, and the locomotives were working the full length of the Wyoming Division as needed.

Stan Kistler

Turbine 53 was also at Cheyenne on October 1, 1954. The shield over the air intake unit and the absence of chrome side grills make for a considerable difference in appearance of the two "sisters."

Emil Albrecht

With the snow sprinkled Wasatch Range providing the background, turbine 54 waits on a side track north of Salt Lake City near Kaysville, Utah, with a northbound drag. It's the late afternoon of May 5, 1956.

Thos. R. Lee

There were basically two styles of roof air intake housing units used on the small turbines, and #53 is shown at Laramie, Wyo., August 20, 1957, with the "raised" style. The first gas turbine to have the air intake moved to the roof, #53 had several different appearances during its service. These changes are noted on other photos of the locomotive in the book.

J. A. Rutherglen

Turbine 52 and a three unit set of F-7 diesels, headed by the 1478, doublehead a westbound manifest out of Green River, Wyoming. Both locomotives arrived on the system in early 1952.

Both photos, Henry R. Griffiths

In a scene that both turbine and steam fans would like to see today, turbine 53, with the help of 2-10-2 #5522 pushing, is moving a 100 car eastbound at 20 miles per hour on the afternoon of July 1, 1952, four miles east of Echo, Utah, on the 1.14% grade in Echo Canyon.

Trains: *Wallace W. Abbey*

"I Rode The Big Blow" is the name of an excellent article in the July 1953 issue of TRAINS MAGAZINE. Wallace W. Abbey, Managing Editor of the magazine at that time, was the man who rode the "Big Blow", turbine 54 on March 1, 1953, and very colorfully reported his experience. Through the courtesy of Mr. Abbey and David P. Morgan, Editor of TRAINS MAGAZINE, the following photos and comments appear. If you still have a copy of that issue, be sure to read it again.

"Ogden, Utah, lies in Great Salt Lake Valley at the foot of the Wasatch Mountains. I looked at those snow-mantled peaks through the fireman's window of the 54 as we pumped up the air in the yard. X-54 East, a manifest of general freight and lumber. 86 loads, 10 empties, 5029 tons. We would go over the hill with full tonnage. Ahead was the climb up along the Weber River and Echo Creek, 65 miles of rugged pull for which we'd have the help of the 3708, a 4-6-6-4 "Challenger" articulated, back at the caboose."

The fireman obligingly cleaned the windshield so that Wallace Abbey could capture the trip on film, and the pictures on the next two pages tell part of the story.

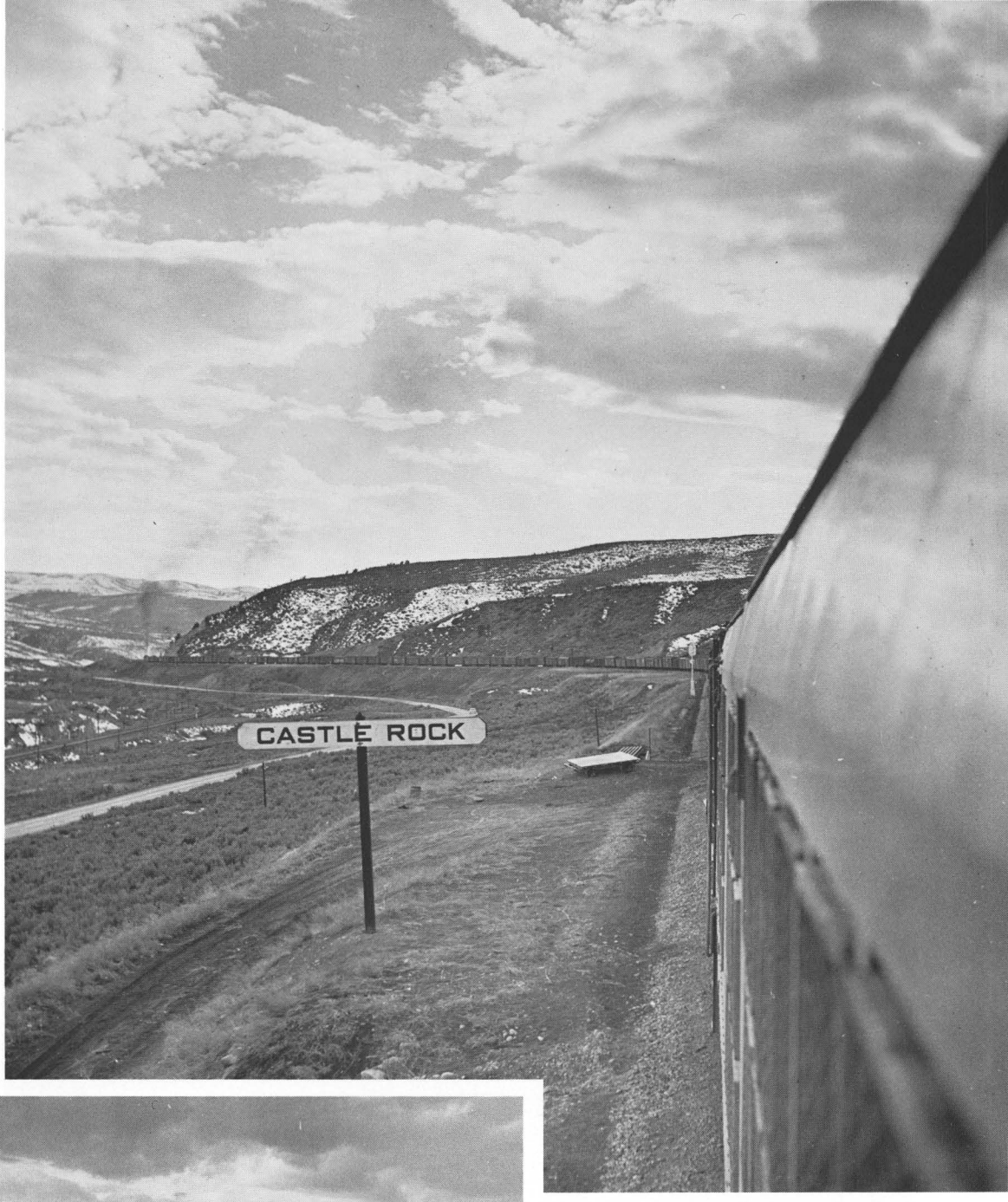
"The battle with altitude and gravity was joined. Our two engines, turbine at the front and steam at the rear, got down to business. As the steep walls of Weber Canyon opened to admit the two tracks of the Union Pacific main line, turbine 54 met turbine 51, drifting downhill on the last leg toward Ogden."

Trains: *Wallace W. Abbey, both photos*

"A westbound diesel freight, headed by the 1426, comes out of the yawning jaws of Echo Canyon and hurries through Echo, Utah, on its way to Ogden. Our nose was pointed up the killing 1.14 per cent grade which extends with hardly a break from Echo 25 miles to the summit at Wahsatch. The real fun was about to begin."

"We started to climb up Echo Canyon where, with a mile of train between us, I, seated in the cab, was always 60 feet higher than the conductor seated in the caboose.

"Then the eastbound track left the westbound and began to follow its own path higher and higher on the side of the canyon. The sign and siding at Castle Rock came up and passed. In the rear-view mirror I could see our 96 cars strung back around a curve and the smoke of our helper rising in a furious geyser."



Trains: *Wallace W. Abbey*

"And then we were at Wahsatch, the top of the Wasatch Range, in country that was refreshingly flat and far-flung after the 65 miles of canyons."

The westbound transcontinental streamliner "City of Los Angeles" passes Extra 54 East, which has stopped to cut off its helper.

Thos. R. Lee

Bypassing the new line over Sherman Hill, #53 rolls by the previous site of Corlett Jct., Wyoming, at 35 miles per hour with a westbound hotshot of 34 cars on the morning of September 1, 1956. Note that the shield over the air intake still remained.

Richard Steinheimer, Everett L. DeGolyer Library

The turbine era was young when Dick Steinheimer caught #52 moving down Echo Canyon with a westbound manifest in the summer of 1952.

Emil Albrecht

Turbine 56 has left Riverdale Yard at Ogden, Utah, in the afternoon of October 2, 1955, with an eastbound. There is a shield over the air intake like on #53.

Thos. R. Lee

Turbine 55 heads into the Cheyenne receiving yard with an 89 car eastbound extra on August 22, 1957. A Wyoming rainstorm is moving in from the northwest and will soon give both the photographer and the train a drenching.

Turbine 52 is west of Kearney, Nebraska, on August 25, 1956, with a 91 car westbound. With the addition of the fuel tender, the GTE's began operation to Council Bluffs in 1956.

Minus its fuel tender, #51 is rolling 55 miles per hour as it handles a 112 car eastbound hotshot west of Grand Island, Nebraska, on the morning of August 26, 1956. The 4500 horsepower turbines retained their steam generators for use with or without the insulated fuel tenders.

Turbine locomotives were much in evidence at Laramie, Wyoming, on August 20, 1957, as eight GTE-4500's were recorded on the first trick train sheet. #56 waits for a late afternoon call while #53 sits under the coal chute.

All photos this page by Thos. R. Lee

R. H. Kindig

In the twilight of its career, turbine 58 with diesels 340-B and 185-B is shown pulling out of the siding at Archer, Wyoming, with a westbound 101 car drag on July 14, 1962. Usefulness of the turbines was greatly increased when provision was made for multi-unit operation with diesels.

R. H. Kindig

On September 18, 1954, GP-9 diesel units 225, 201-B, 240, and 197, new additions to the roster that year, failed on a 68 car westbound extra on Sherman Hill near Lynch, Wyoming. Turbine 59 was called to the rescue and is shown powering the train near Harriman.

Union Pacific Railroad

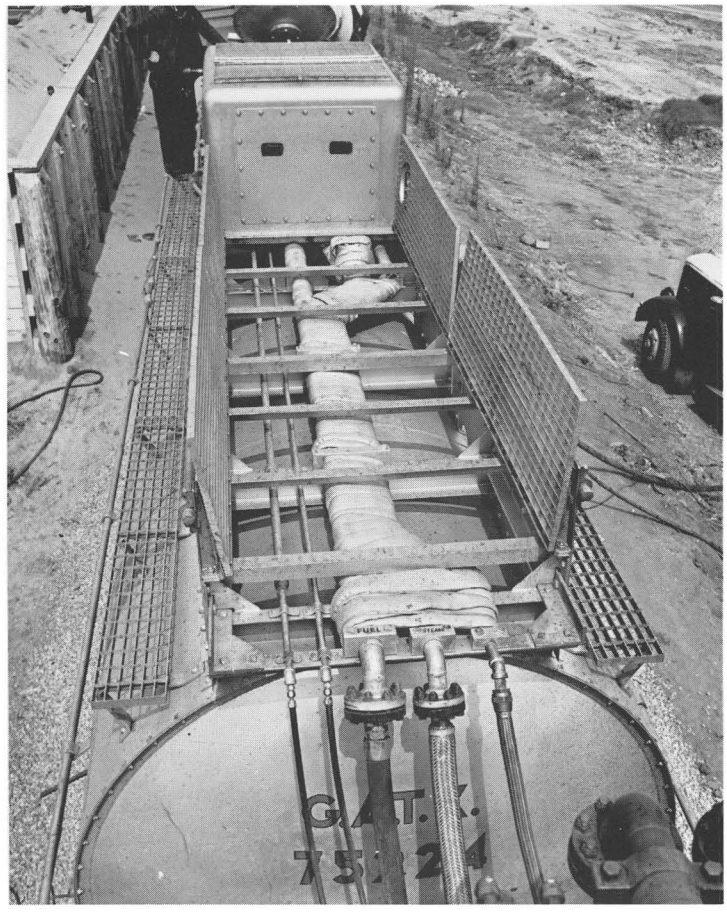
Propane turbine #57 had a date with the TV cameras as the star of Richfield Oil Corporation's film, "Success Story". Ex-Virginia & Truckee #18 and U.P. 2-8-2 #2709 added smoke to the film to show the evolution of motive power development in the twentieth century.

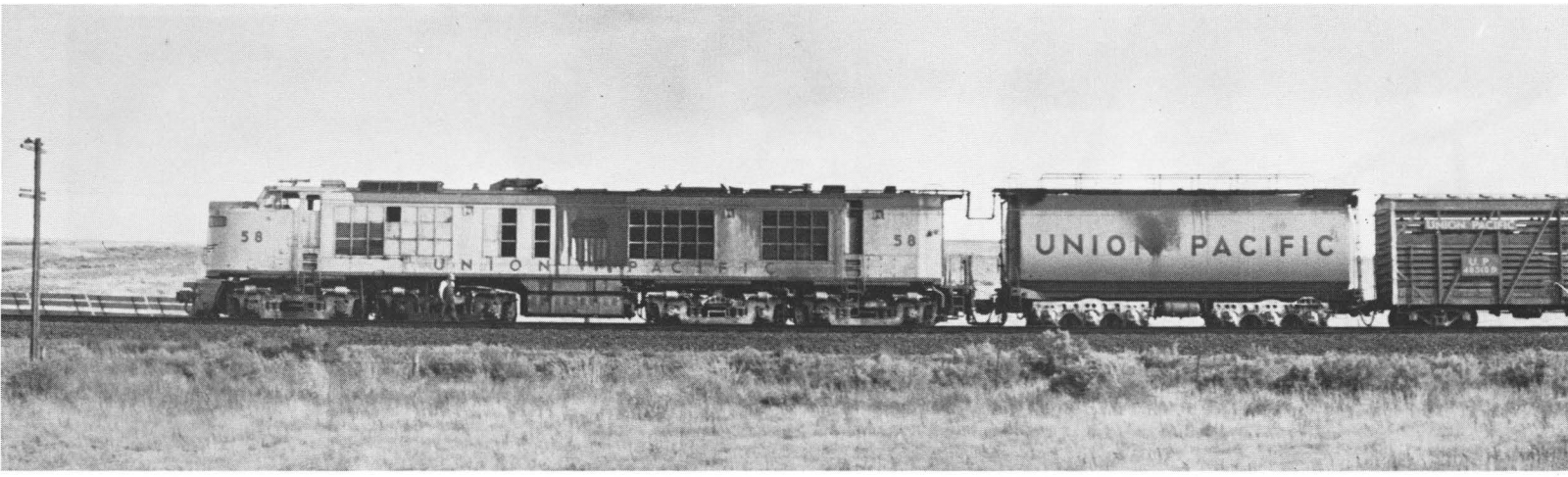
Union Pacific Railroad

This propane fueling station was located at East Los Angeles. "No Smoking" was the rule to live by when working around the highly volatile fuel.

All photos Union Pacific Railroad

These four photos show the propane turbine taking on sand at East Los Angeles, (upper right) the hose connections between the locomotive and tender, and (lower) roof views of both #57 and the tank car tender. Note the propane line protection chamber on the right side of the roof on #57. The middle hose line is for steam while the other connections are control and air lines.





Emil Albrecht

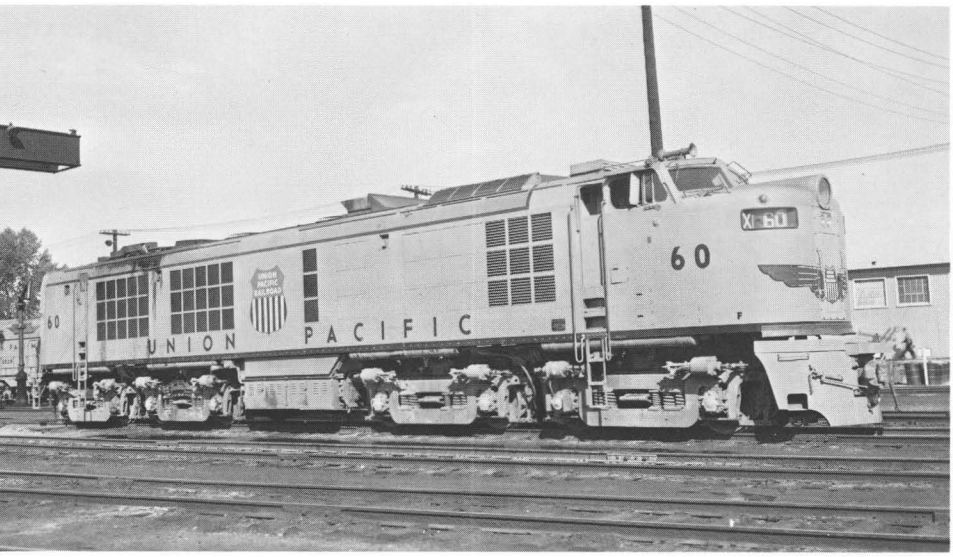
The Union Pacific shield is almost covered with turbine oil grime in this photo of turbine 58 in a siding east of Wamsutter, Wyoming, on August 28, 1957.

Echo Canyon is the site of #59 with two GP-9's working hard on an eastbound extra. Separation of the double track main line through part of the canyon creates the false illusion of single track.

Leon Callaway

Robert H. Heuerman

Santa Fe employee Robert H. Heuerman captured the propane turbine on film at Summit, California, on Cajon Pass during the summer of 1953 with this westbound extra.

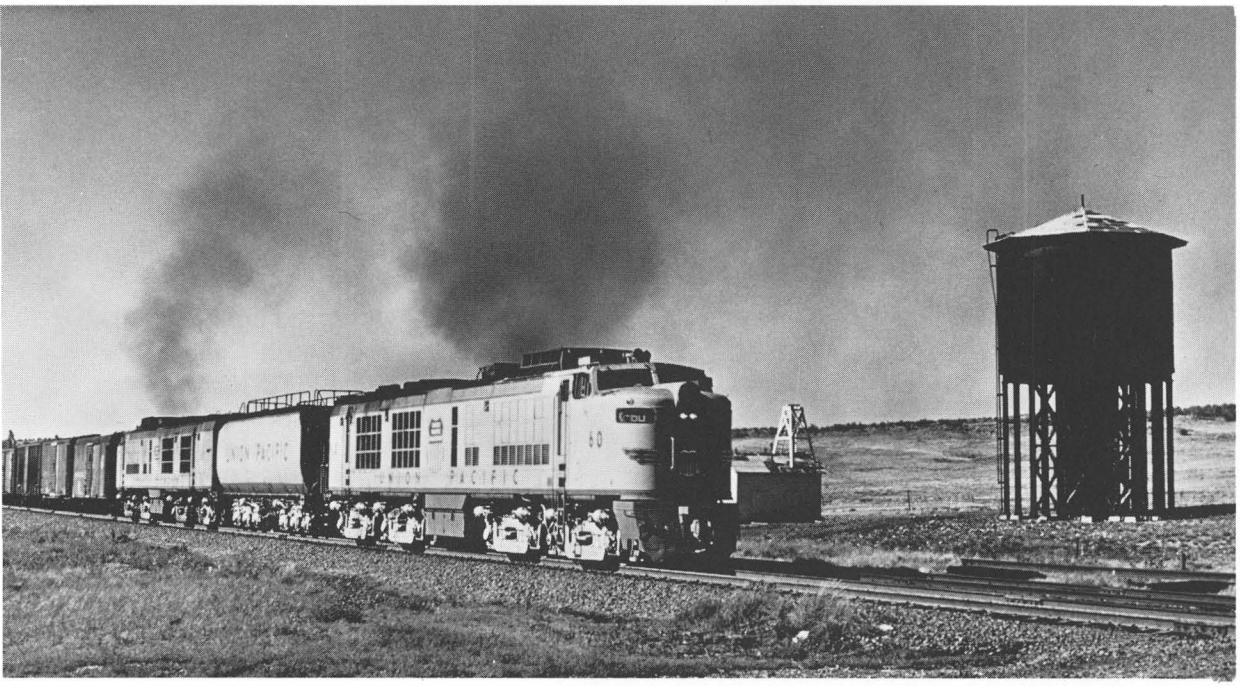


Paul R. McDonald Collection

Turbine 60 was the last of the ten carbody gas turbines and had a builders date of August 1953. The unit is shown at Ogden, Utah, July 14, 1954.

Paul R. McDonald Collection

Turbines 60 and 59 are being serviced at Ogden, Utah, on October 1, 1958, in this photo taken by the late Don Roberts. The two locomotives were being tested in multi-unit service with a single tender at the time. The 9,000 horsepower combination always ran with #60 as the lead unit after initial problems and subsequent modifications restricted #59 to trailing unit status.



Henry R. Griffiths

The double turbine combination was run in tests for almost five months. Numbers 60 and 59 are shown at Red Buttes, Wyoming, with an eastbound extra on September 18, 1958.

Noted railfan and publisher, Donald Duke, snapped X-52 East crossing the Green River in July 1953 at the west edge of Green River, Wyoming.

Donald Duke

Turbine 55 and GP-9's 305, 317B are rolling 50 mph west of Speer, Wyoming, June 30, 1962, with a 77 car westbound manifest. The ten year old locomotive was the oldest GTE on the roster on that date as the first four had already been retired earlier in the year.

R. H. Kindig, Paul R. McDonald Collection

Turbine 60 had the chance to operate on the South Central District when the GTE locomotives were occasionally run through to Los Angeles in the summer of 1962. The unit, with SD-24 403, is pictured at East Los Angeles on July 26, 1962.

Paul R. McDonald Collection

Union Pacific Railroad

The 61-75 class locomotives had the same specifications as the earlier carbody models, except they were 83' 8½" long without tender and had an extreme height of 15' 8 5/16". Number 61 is shown at Salt Lake City, Utah, November 1, 1955, after receiving the first auxiliary tender, which the small turbines were to receive during the following year.

Thos. R. Lee

Another freshly painted turbine, #63, has started the assault on Sherman Hill with a 44 car westbound extra. Photographed at Speer, Wyoming, September 2, 1956, the hotshot is moving at 35 miles per hour.

Thos. R. Lee

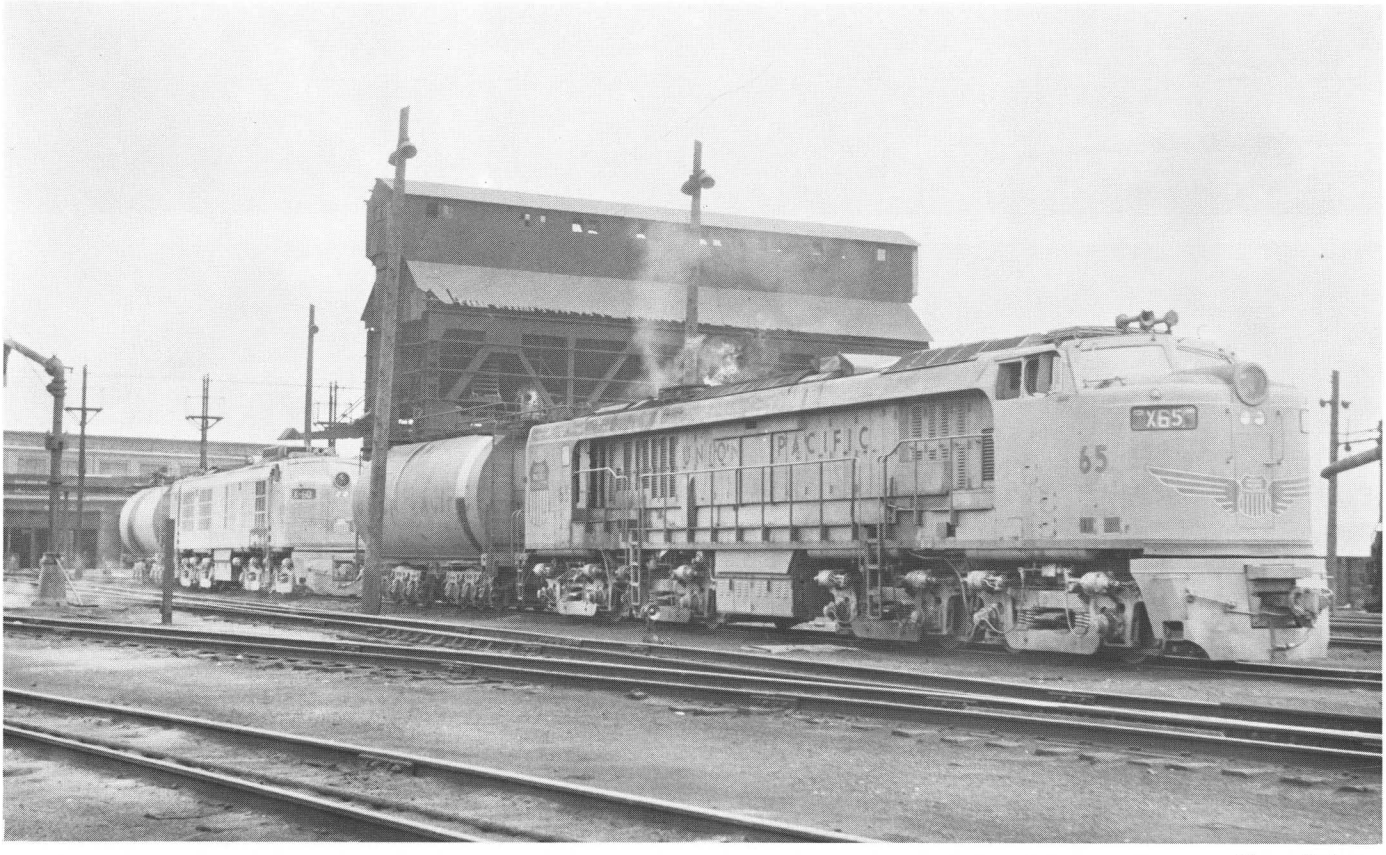
The turbines were occasionally used eastbound to Cheyenne in 1954 with the arrival of the second series. Less than three months old, #62 arrives at Laramie with a 77 car westbound on July 2, 1954.

R. H. Kindig

Double-heading of turbine and steam was a rarity, but "Big Blow" 61 and "Big Boy" 4017 are handling a 100 car westbound extra near Speer, Wyoming, at 30 miles per hour on September 4, 1955.

Thos. R. Lee

One of the first trains the author saw on his initial trip to Laramie, Wyoming, July 1, 1954, was turbine 67 leaving with a 68 car extra on its first trip west. The rider caboose for technicians was a common sight behind new power.



Thos. R. Lee

Against a backdrop of the Cheyenne coal chute, both classes of the 4500 horsepower turbines are in evidence on the ready track August 22, 1957, as #65 and 60 await westbound calls.

Henry R. Griffiths Collection

The late Don H. Roberts, noted railfan at Portland, Oregon, photographed many of the 4500 horsepower turbines at Ogden, Utah, in the early years of their service. Number 66 was relatively new on July 12, 1954, while #69 was showing some turbine oil grime in a photo taken several months later.

Stan Kistler

Turbine 70 with roaring exhaust is shown waiting at North Platte, Nebraska, on the morning of November 9, 1956, before continuing an eastbound run.

Emil Albrecht

Turbine 61 received a new tender, built for the 1-30 series turbines, when the locomotive was run in multi-unit tests with diesels in the fall of 1958. The "Big Blow" still had the tender when Emil Albrecht caught #61 at Ogden, Utah, on July 5, 1959.

Emil Albrecht

Of all the turbines, the "Verandas" had the most style. Number 63 faces a setting sun at Ogden, Utah, on March 18, 1956.

Don H. Roberts, Paul R. McDonald Collection

The 68 is brand new as it sits at Ogden, Utah, July 14, 1954.

Byron E. Guise

Turbine 67 made two round trip test runs on the Kansas Division's Topeka Cut-off between North Platte and Kansas City on May 24 and June 10, 1956. The trainmaster is watching proceedings as an engine crew change takes place at Marysville, Kansas, on the initial trip west.

Emil Albrecht

Teaming up on an eastbound coal drag, turbine 75 and 4-8-8-4 #4009 are slowly moving down the outside yard track at Laramie, Wyoming, August 25, 1957.

Union Pacific Railroad

Turbine Action! X-65 East slowly moves up the middle passing track at Peterson, Utah, with a fruit train as another "Veranda" roars down grade with a hot stock train. Weber Canyon is in the distant left background while the tranquil stream in the foreground is the Weber River.

Union Pacific Railroad

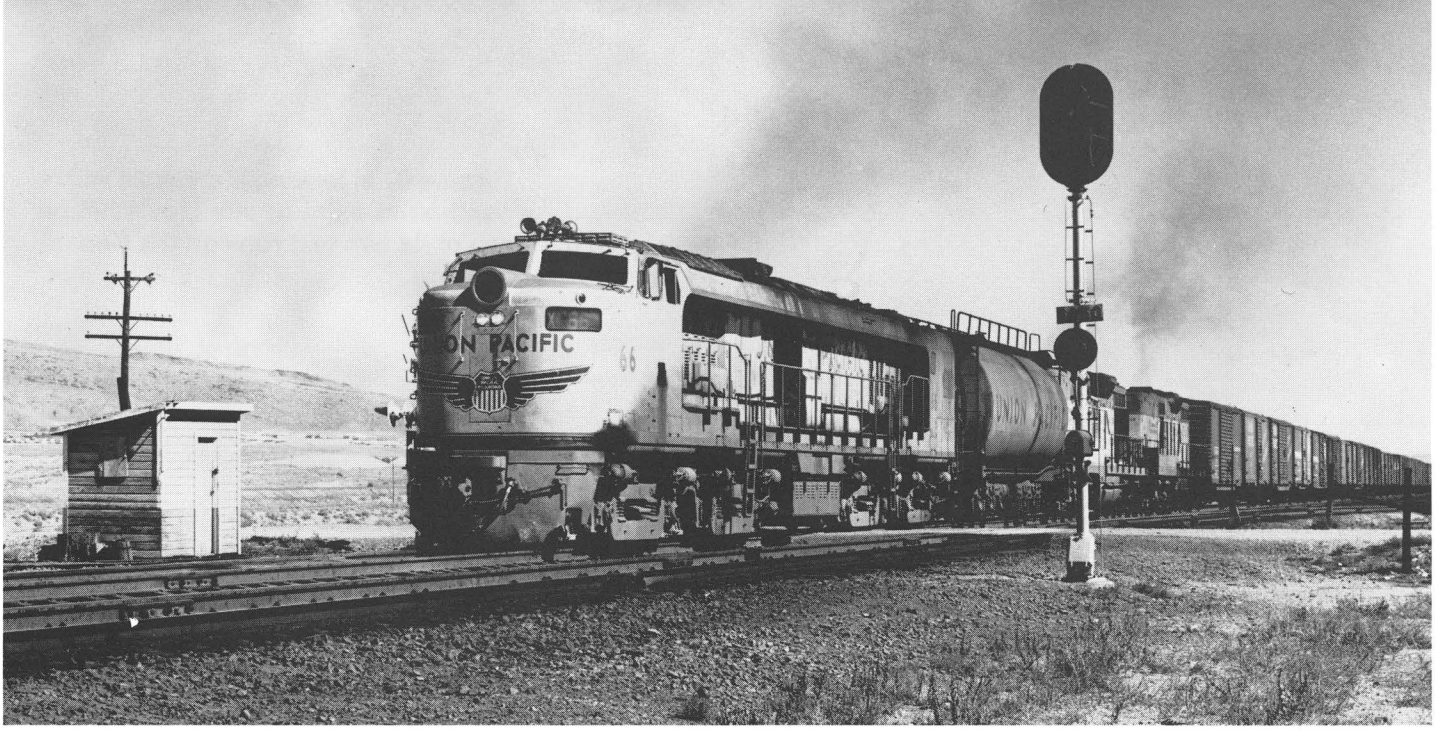
Three miles west of Wahsatch, Utah, the westbound main line crosses over the eastbound line on a curving steel trestle after emerging from a tunnel. X-73 West, with two "Geeps", starts the descent through Echo Canyon on July 17, 1960; while an eastbound fruit train, headed by an 8500 horsepower turbine, ducks into the lower tunnel.

T. M. Hotchkiss

The 4500 horsepower turbines were regularly used in multi-unit operation with GP-9 diesels starting in 1959. Turbine 73 is shown east of Rock Springs, Wyoming, with an eastbound on September 21, 1959.

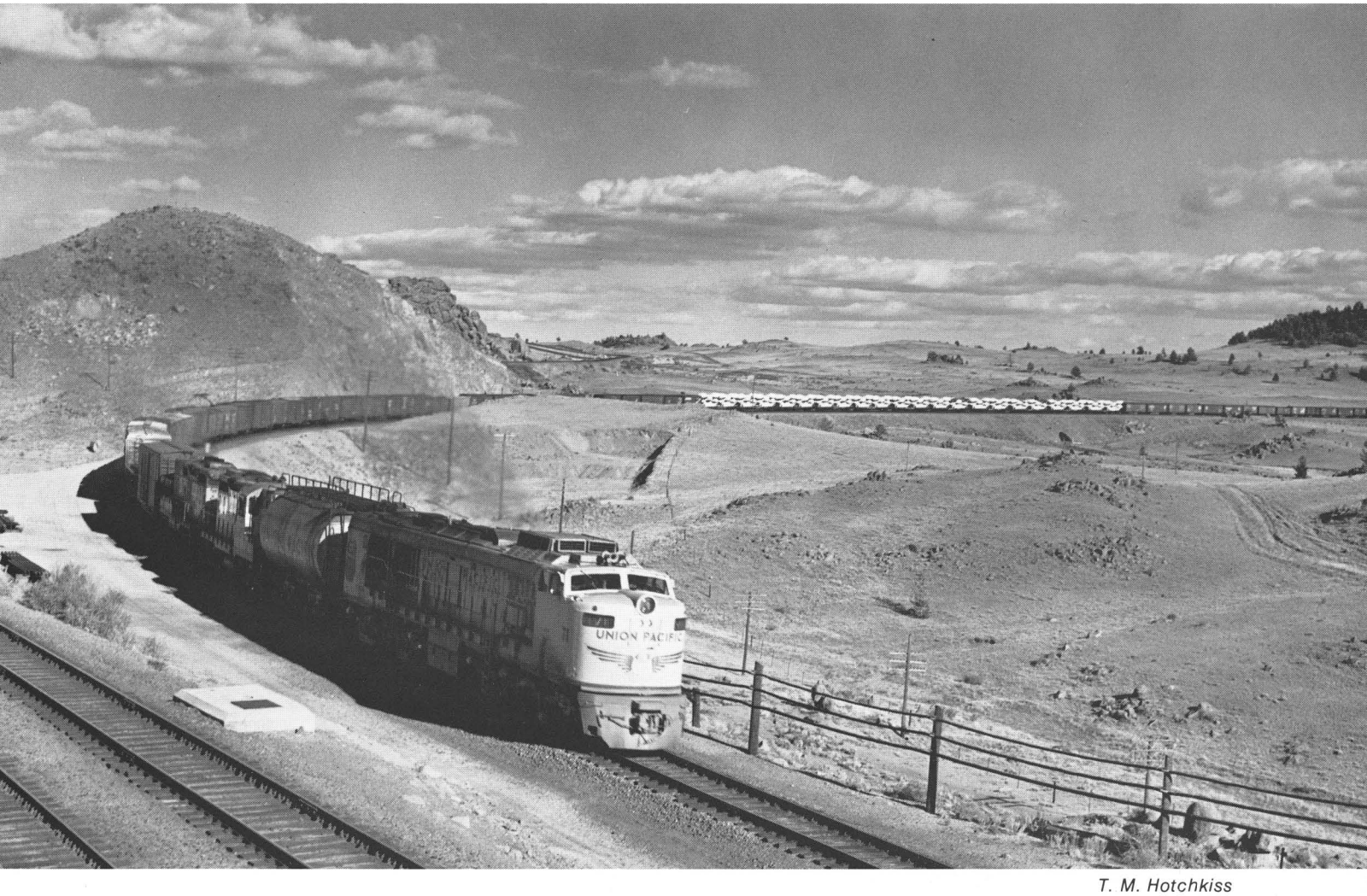
T. M. Hotchkiss

Turbine 65 and three SD-24 diesels, headed by the 413, are working this westbound over Cajon Pass in August 1962. Note the unusual air intake unit on #65, the only turbine believed to have received the big "breather." The four month use of turbines on the California Division was about over when Tom Hotchkiss caught this manifest.



T. M. Hotchkiss

Turbine 66 with two "Geep" B units comes roaring out of Rawlins, Wyoming, on September 28, 1963, with a westbound hotshot merchandiser.



T. M. Hotchkiss

On a beautiful Indian Summer day in Wyoming, turbine 71 with two GP-9's climbs Sherman Hill with a westbound at Dale on September 23, 1960.

Byron E. Guise

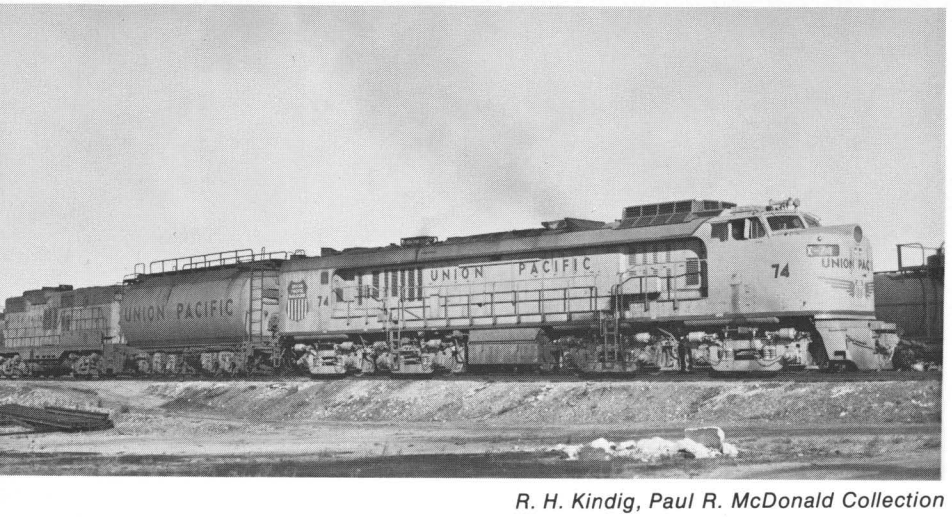
Turbine 67 is leaving Marysville with a westbound extra in late May 1956 on one of its two test runs on the Kansas Division.

R. H. Kindig

Turbine 68 heads straight into a setting sun on July 7, 1956, as the Big Blow moves a westbound extra of 107 cars at 25 miles per hour west of Speer, Wyoming.

R. H. Kindig, Paul R. McDonald Collection

Turbine 69 is moving 25 miles per hour under the highway bridge at Archer, Wyoming, with an eastbound drag of 108 cars on August 12, 1961. The "Union Pacific" across the nose was added to all turbines and diesel "A" units during 1960.



R. H. Kindig, Paul R. McDonald Collection

Number 74 with a single GP-9B moves through the Cheyenne yard on September 16, 1961.

Thos. R. Lee

On the rainy, wet morning of August 20, 1957, #71 enters the yard at Laramie with a 60 car westbound. The 4500 horsepower turbines would tend to slip on wet rail.

Thos. R. Lee

The rainy weather continued the next day, and a grimy turbine 72 is shown moving through the mist toward the Laramie service area after arriving with an eastbound.

Thos. R. Lee

With the battle against Sherman Hill over, turbine 75 is entering the Laramie, Wyoming, yard on track 7 with a 95 car westbound on August 20, 1957.

Emil Albrecht

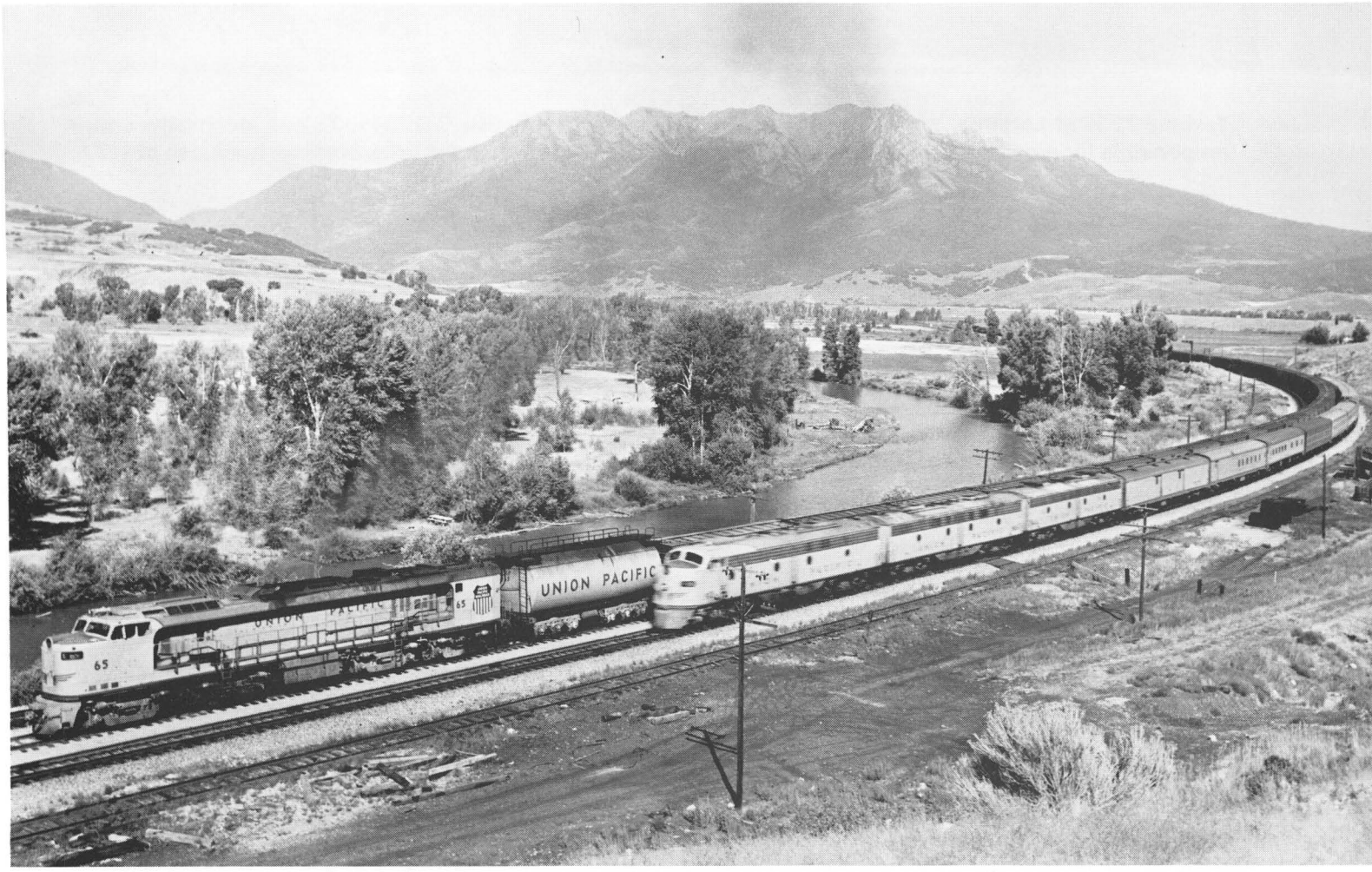
Waiting for a red block to clear, turbine 71 is holding the main line near Wahsatch, Utah, with an eastbound on July 5, 1958. Note the small size lettering on the tender.

Emil Albrecht

Turbine 70 is ready to leave Green River, Wyoming, with a westbound extra on July 4, 1957. The terrain around Green River provides a colorful background for railfan photography.

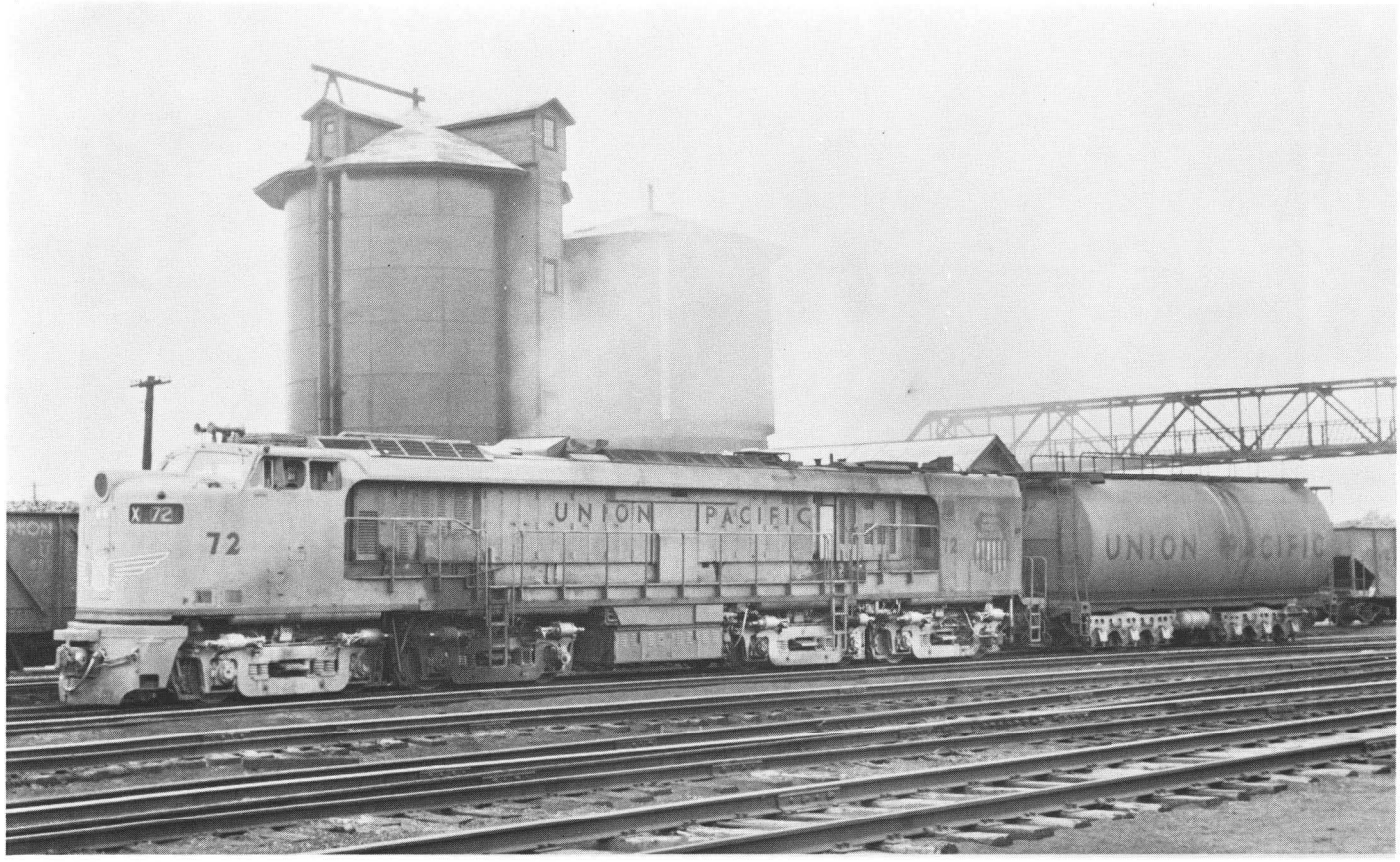
Emil Albrecht

Turbine 69 with two GP-9's moves down the lead track at Ogden, Utah, as the eastbound pulls out of Riverdale Yard on July 5, 1959. The double track main line is to the right under the signal bridge.



Union Pacific Railroad

The eastbound Domeliner "City of Los Angeles" has emerged from Weber Canyon, in the distance, and moves around X-65 which is slowly moving up the middle passing track at Peterson, Utah.



Thos. R. Lee

Turbine 72 is at Laramie, Wyoming, August 21, 1957. The twenty-five GTEL-4500 class locomotives were responsible for moving over ten percent of all Union Pacific tonnage in the brisk summer business of 1957.

Thos. R. Lee

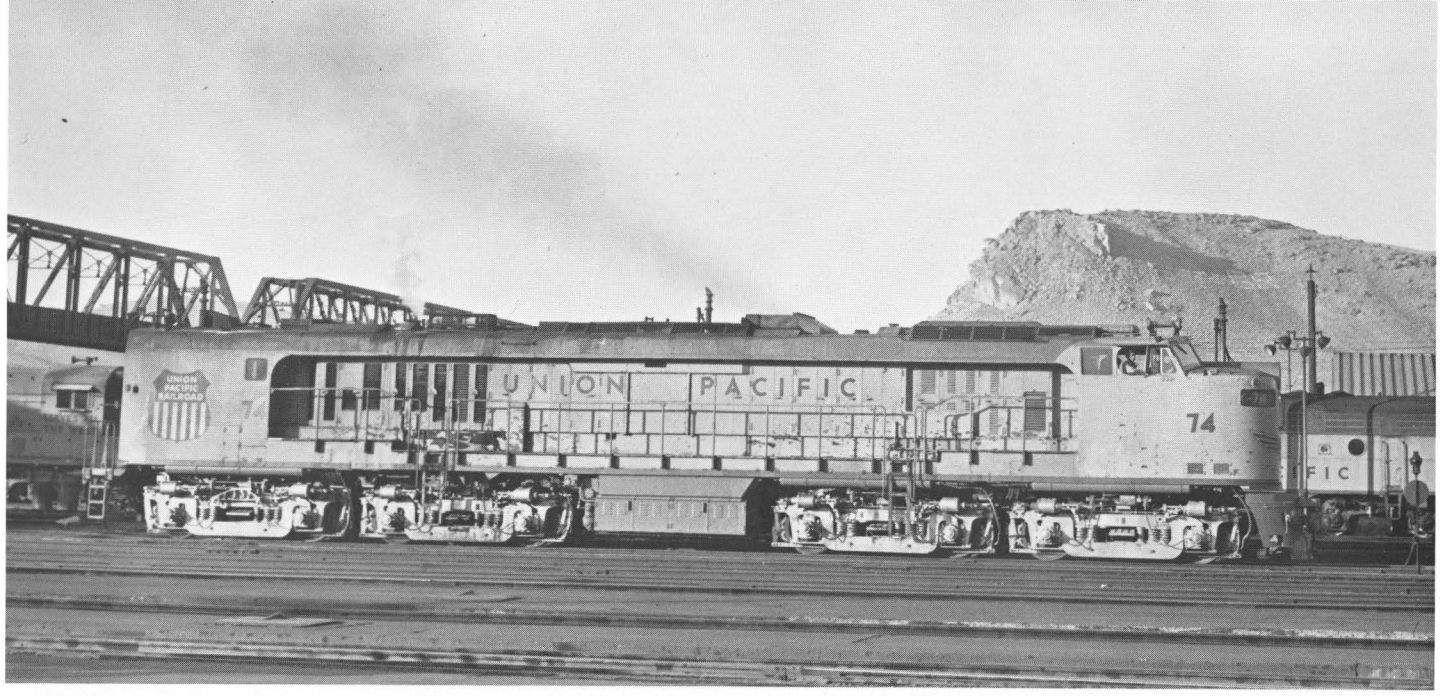
Turbine 73, in sparkling new paint, has just topped Sherman Hill at 35 miles per hour with a 78 car eastbound extra on September 2, 1956. The dynamic brakes will give the noon stock train a smooth ride into Cheyenne.

Emil Albrecht

An early morning visit to the Green River yard on August 22, 1956, found turbine 74 leaving town with a long westbound reefer drag that stretched as far as the eye could see.

Emil Albrecht

This shot of number 75 at Green River was taken August 15, 1958, and shows the "Veranda" in a classic roster pose.



Emil Albrecht

Turbine 74 backs down for its westbound train at Green River, Wyoming, on August 22, 1956.

Emil Albrecht

Some of the picturesque setting of Green River, Wyoming, has been captured in this photo of turbine 75 leaving town with a westward extra on August 15, 1958. For many years the tall smokestack at the U.P. roundhouse was as much a landmark as Castle Rock and the surrounding mountains.

Turbine 72 is approaching Devils Slide east of Morgan, Utah, with an eastbound general merchandise train on July 5, 1958.

Emil Albrecht

Emil Albrecht

A scene to behold in a bygone era! "Big Blow" 75 and "Big Boy" 4009 start the eastbound battle against Sherman Hill as they leave Laramie, Wyoming, on August 25, 1957, with a long coal train. The sun lit cloudy sky only adds to the railroad drama taking place.

Thos. R. Lee

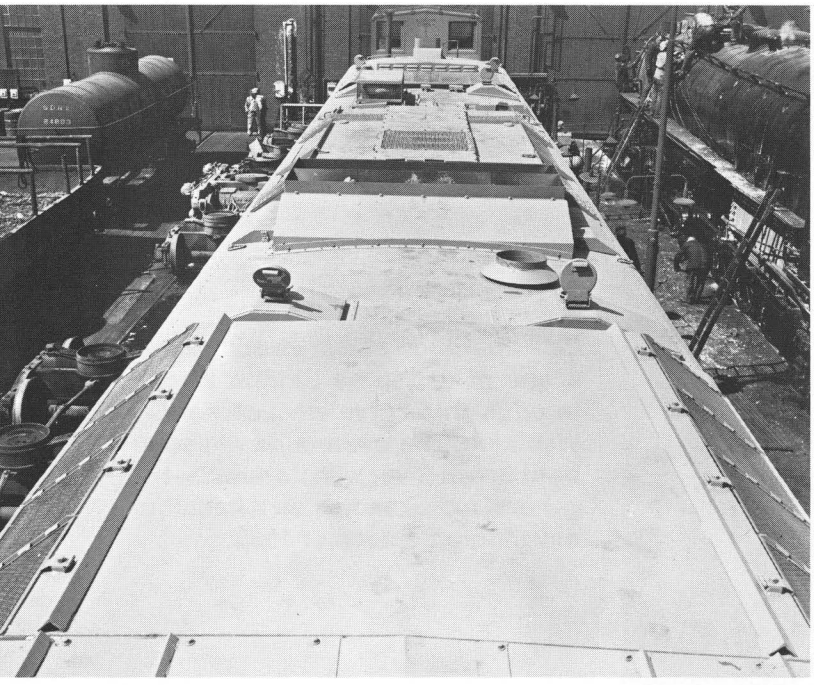
X-67 East is ready to leave Laramie, Wyoming, on August 20, 1957, with an 88 car "Green Fruit" manifest bound for eastern markets. The engine crew that has just boarded has the train moving at only 15 miles per hour until the occupied westbound main line clears, then the hotshot will cross over to left hand operation and begin the assault on Sherman Hill.

Emil Albrecht

Turbine 75 and 4-8-8-4 #4009 are approaching Hermosa, Wyoming, with an eastbound extra on August 25, 1957.

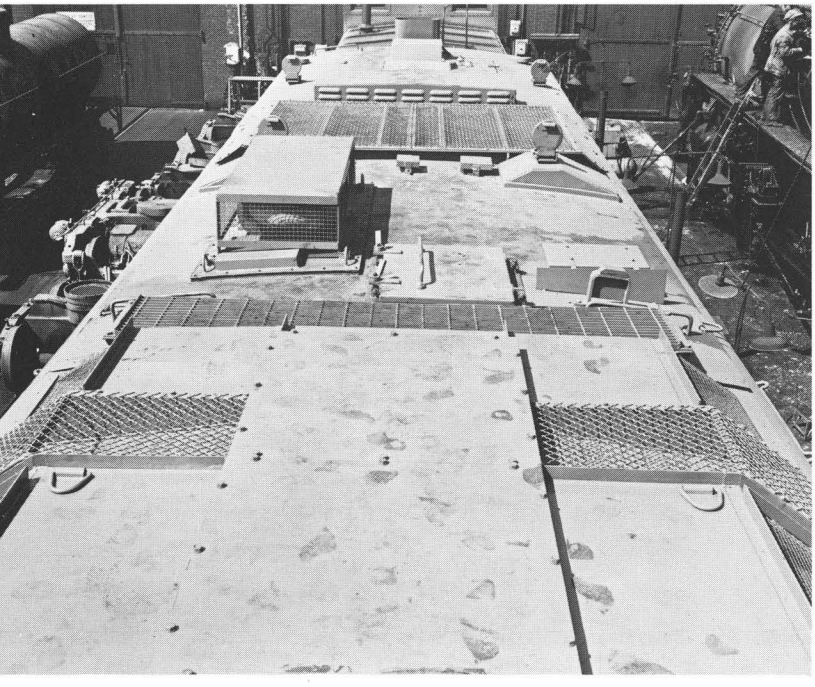
The turbines were run through to Los Angeles for four months in 1962, and 12,800 horsepower headed by #60 has topped Cajon Pass at Summit, California, April 28 on its first trip east. Coupled behind the turbine are two SD-24's and two GP-9's.

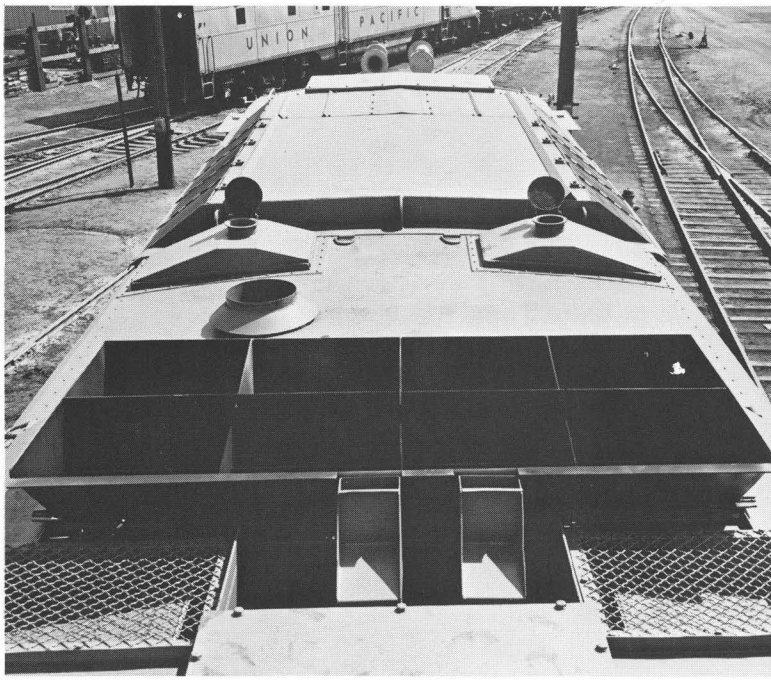
Chard Walker



All three photos by Union Pacific Railroad

These three photos show the top detail of a 61 class turbine. (Left) Looking to the rear from the cab roof, the components from the bottom of the picture are the turbine air intake, two sand box fill openings with lids raised, the turbine air intake stack on the right side, and the turbine exhaust opening. (Lower left) The turbine exhaust was followed by the dynamic brake grids, auxiliary diesel muffler and exhaust housing on the left side, two more sand box fill openings, control cabinet air intake, two more sand box fill openings, and the steam boiler exhaust stack. The photo (below) is looking forward and shows the turbine exhaust opening, turbine air intake stack, two sand box fill openings with lids raised, the turbine air intake, and cab roof with double horns. Note 4-12-2 #9051 receiving repairs and E-6 diesel 987 being moved to the shops. The photos were taken at Omaha.





The initial run of the "Super Turbine" was August 31, 1958, and #1, trailing twin tenders, is shown leaving Omaha with an 80 car westbound at 30 mph.

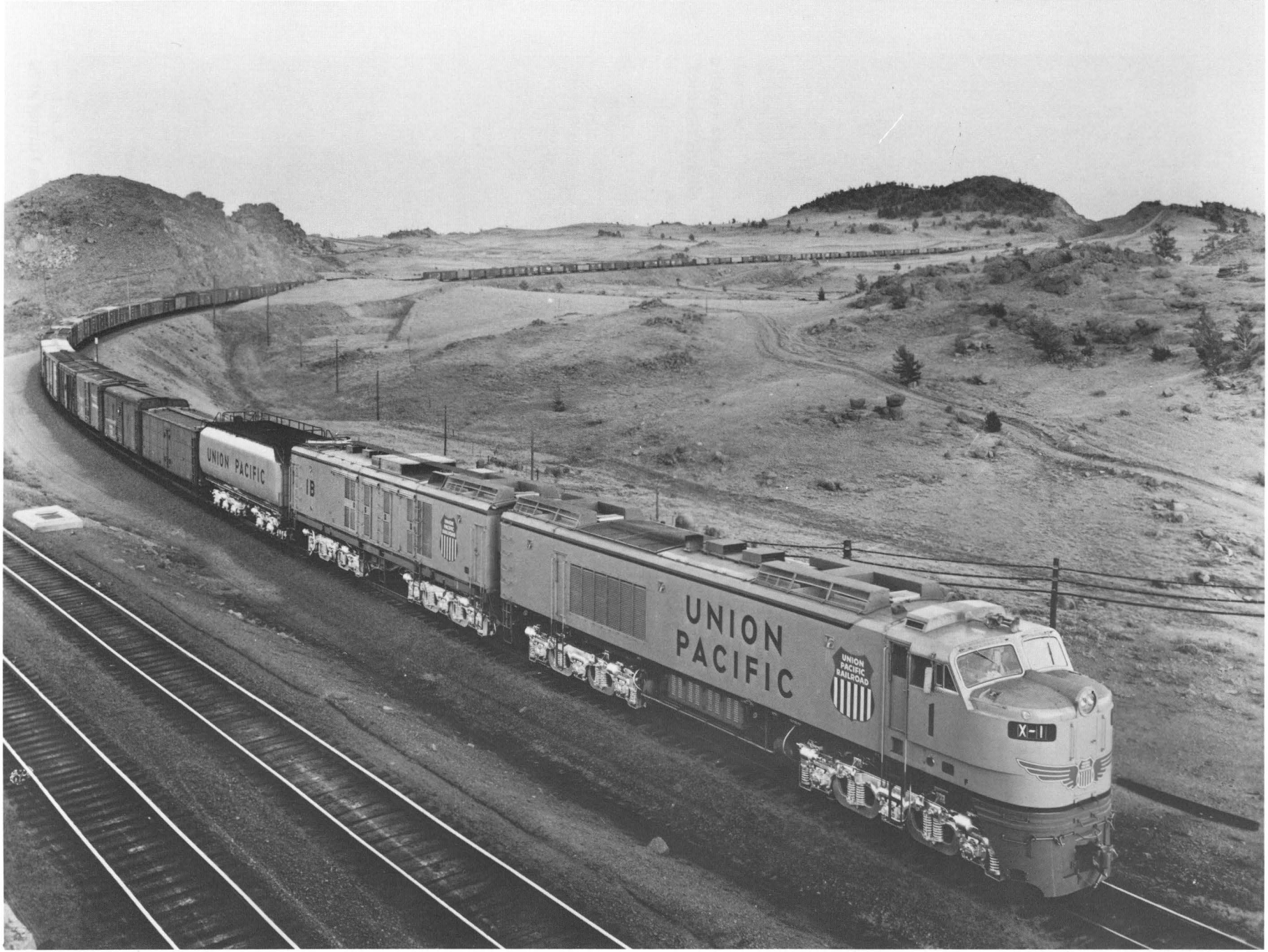
Wm. W. Kratville

T. M. Hotchkiss

Late afternoon shadows add to this scene of action as turbine 2 rolls through this curve west of Kanda, Wyoming. The westbound will soon be in Green River with its manifest of general merchandise on a beautiful day in late September 1963.

Extra 3 East has stopped for a crew change and is slowly moving past the yard office at Laramie, Wyoming, on November 18, 1967.

A. J. Wolff

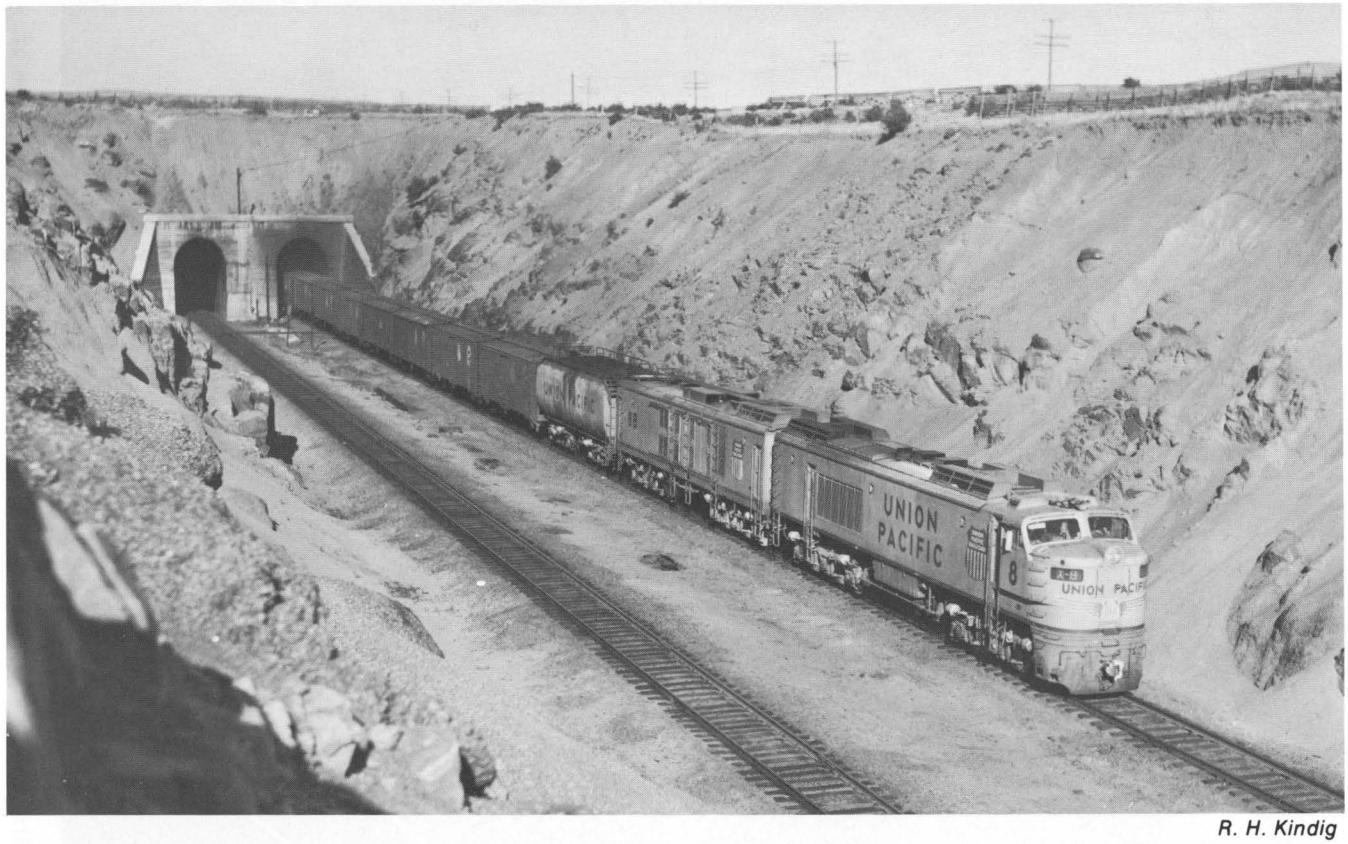


Union Pacific Railroad

The first of the "Super Turbines" is pictured coming off track three at Dale, Wyoming, with a westbound manifest that totals almost 100 cars. This was the initial trip over Sherman Hill for the new locomotive, late in the afternoon of September 1, 1958.

A. J. Wolff

Turbine 5 is pulling out of Cheyenne, Wyoming, past Tower "A" at the west end of the yard onto track 4 with a westbound drag extra on July 13, 1968. The headlight in the distance on track 3 is a 4-unit diesel "hotshot" that will pass the drag before it reaches Speer. Like the turbines, Tower "A" is now gone.



R. H. Kindig

Like a giant yellow reptile emerging from the ground, turbine 8 leaves the east portal of Hermosa Tunnel at 20 miles per hour on July 17, 1960, with a 95 car eastbound fruit train.

Stan Kistler

Archer Hill east of Cheyenne, Wyoming, is the site of this beautiful photo by the noted rail photographer, Stan Kistler. The long eastbound manifest is being powered by new turbine #2 on October 26, 1958, barely a month after delivery. The 8500 horsepower GTE's had a tonnage rating of 10,620 tons between Cheyenne and Sidney, Nebraska. Archer Hill provides the ruling grade on this sub-division, and was the scene of occasional helper engines during the steam age.

J. L. Ozment

Turbine 2, in multi-unit operation with GP-35 #756, has coupled up and is ready to move its westbound train out of Cheyenne on September 25, 1966.

T. M. Hotchkiss

Turbine 2 is a roaring tornado as it speeds through Peru, Wyoming, west of Green River, with this long westbound empty reefer drag on October 3, 1962.

T. M. Hotchkiss

Turbine 7 drifts past block signal #8100 west of Kanda, Wyoming, on October 2, 1962, with a westbound extra. The coloring effects of erosion show in the sandstone hills which are prevalent in the area east of Green River.

Turbine 6 plays the role of a resting giant at Ogden, Utah, April 14, 1962. Except for a short four month period, the "Super Turbines" were confined to the Eastern District between Council Bluffs and Ogden/Salt Lake City.

R. H. Kindig

Double-headed with a set of five F units, turbine 1 prepares to leave Cheyenne on September 27, 1959, with a westbound. Note the addition of the "Union Pacific" lettering across the nose in comparison to photos of the locomotive when new a year earlier.

T. M. Hotchkiss

A. J. "Jack" Wolff recorded this rare scene as #4 was in an eastbound freight east of Laramie, Wyoming, on July 19, 1967. The locomotive was not in mid-train service as it appears, for only the auxiliary diesel engine was running.

A. J. Wolff

R. H. Kindig

The rock formations at Dale, Wyoming, provide a lofty vantage point for railfans to view the first transcontinental railroad at 8,000 feet. Turbine 8 has its 84 car eastbound fruit train moving at 60 miles per hour in the morning of October 14, 1961.

R. H. Kindig

With the morning sun full at its side, turbine 6 is pulling off track three at Dale, Wyoming, with a westward extra of 83 cars on October 14, 1961. The big giant has topped Sherman Hill at 50 miles per hour.

R. H. Kindig

Emerging from Dale cut east of Dale, Wyoming, turbine 7 powers a westbound totaling 112 cars at 40 miles per hour on the morning of October 14, 1961.

When an extra long freight arrived at Cheyenne from the west it was sometimes necessary to pull through the yard onto the "Drill Track", then back the overflow cars onto another track. Such was the case on August 23, 1968, with X-4 East. Turbine 4 would be retired at the end of the month as the first four 8500 horsepower giants were traded back to GE on an order of U-50-C diesels.

James L. Ehernberger

X-9 West is slowly moving through the Cheyenne yard on October 20, 1968, and will soon be on mainline trackage with its manifest of livestock.

Turbine 8 rolls across the barren plateau near Peru, Wyoming, with a westbound on October 3, 1962. Note the four U.P. box cars with the large insignia behind the locomotive.

T. M. Hotchkiss

Turbine 11 and a single EMD unit have topped the grade at Archer, Wyoming, at 40 miles per hour with an eastbound manifest on the morning of August 3, 1968.

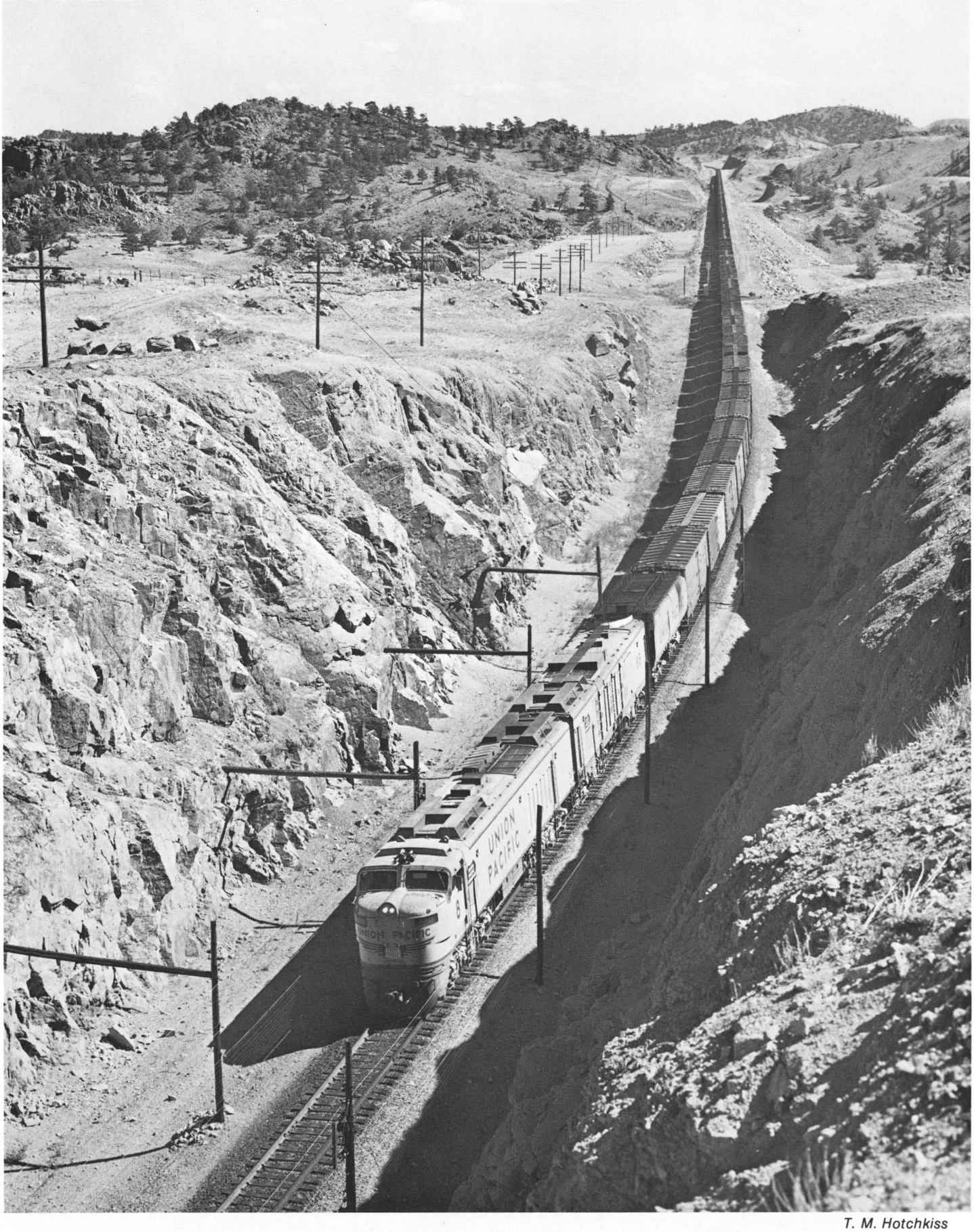
A. J. Wolff

R. H. Kindig

Number 3 is racing in high gear through a cut a few miles west of Laramie, Wyoming. With an eastbound manifest of 118 cars tied to its tender, the big turbine is running 60 miles per hour on the morning of May 18, 1963.

T. M. Hotchkiss

A panorma of the uplands of Sherman Hill dominates the skyline in this shot of turbine 6 and a set of three F units double-heading. The westbound is at Dale, Wyoming, on September 23, 1960.

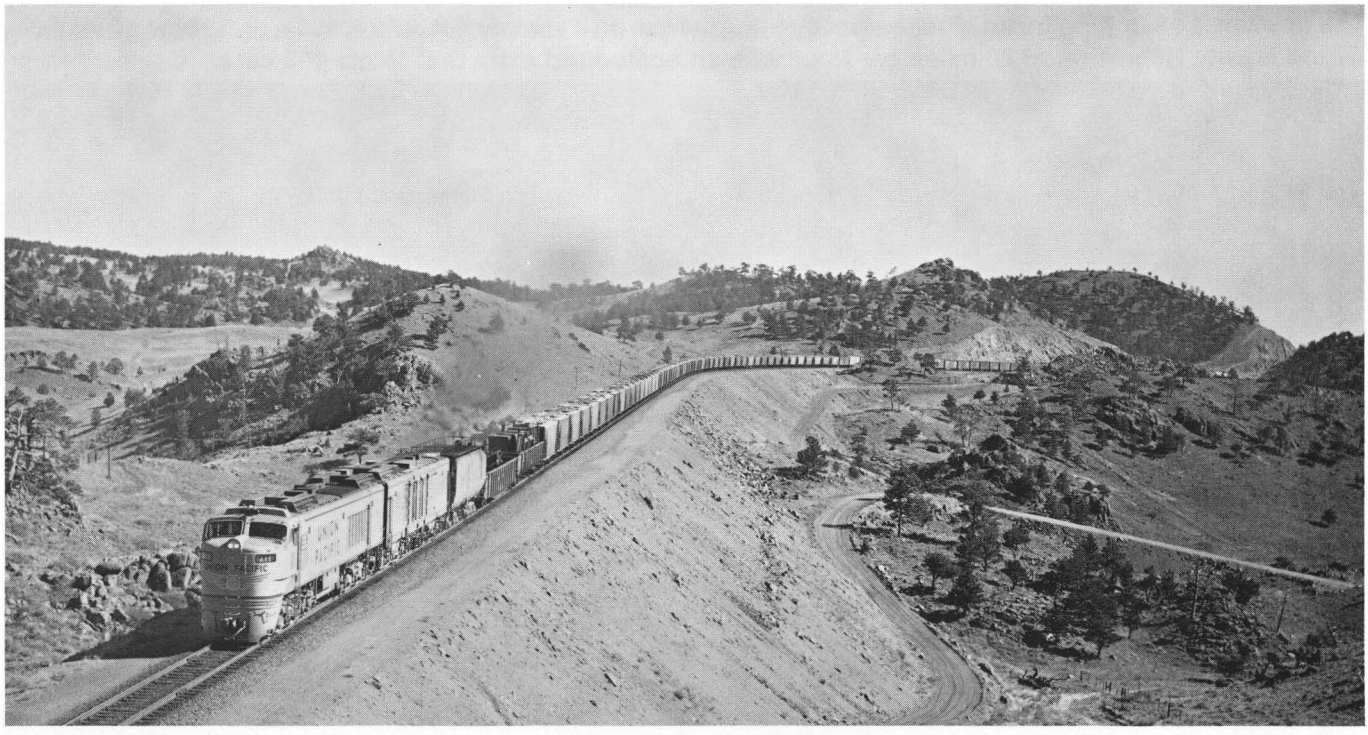


T. M. Hotchkiss

The top of 120 foot deep Dale Cut was the vantage point used to view turbine 8 climbing Sherman Hill with a westbound reefer drag on September 23, 1960. The pine covered rock formations in this area provide a colorful setting for railfan photography.

Turbine 19 has emerged from the narrow confines of Weber Canyon and has its westbound empty reefer drag moving past Uintah. That the train is in Utah is easily seen by observing the "U" on the mountainside, an identifying landmark found at several locations in the Wasatch Mountains. (Below) X-11 West climbs through the rocky, evergreen studded slopes near Perkins, Wyoming, at a steady 30 miles per hour with a westbound drag of 120 cars on the beautiful fall day of October 14, 1961.

Jim Watson



R. H. Kindig

A. J. Wolff

Winter had long since arrived when turbine 15 left Cheyenne with an eastbound fruit train on December 2, 1967.

Thos. R. Lee

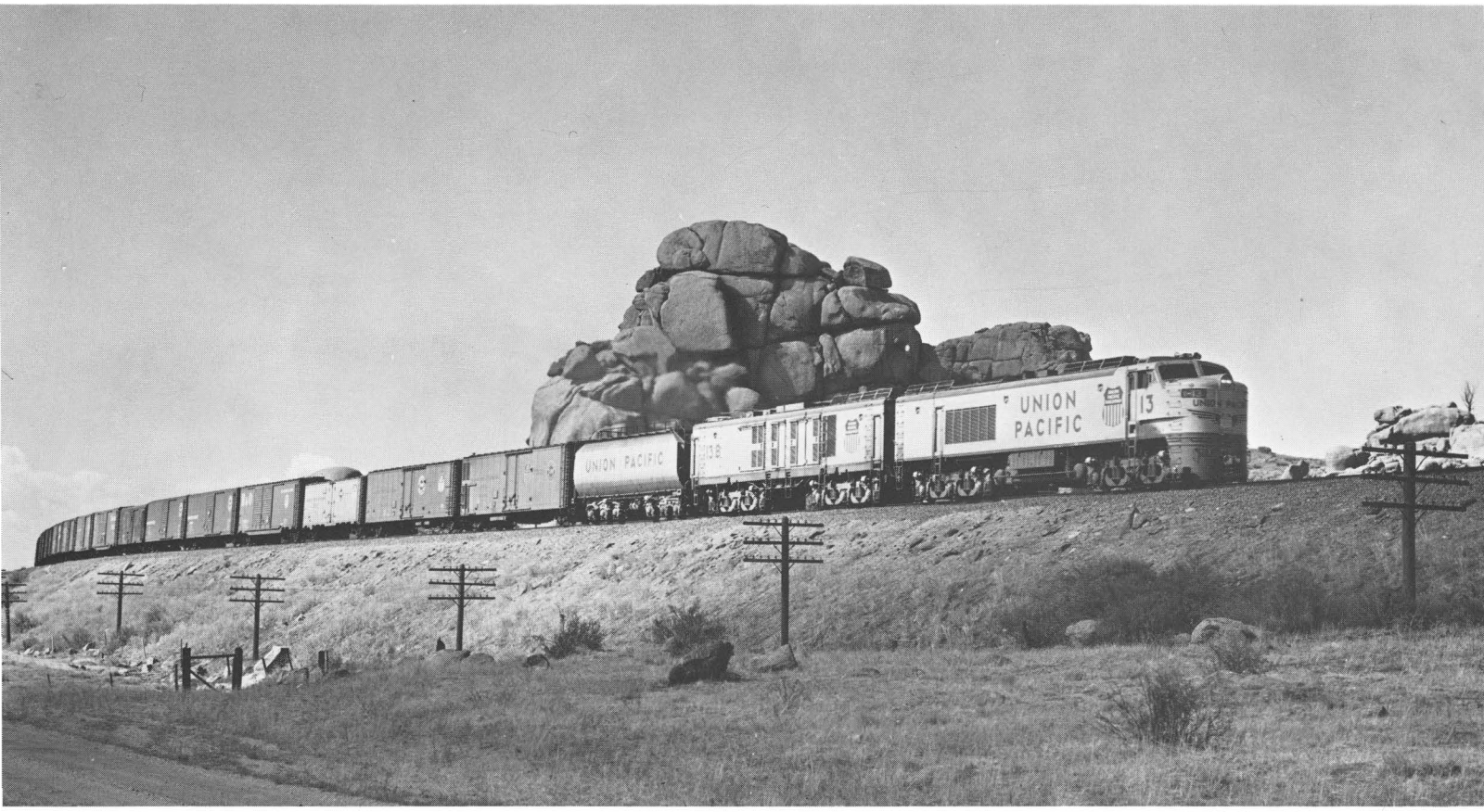
The fireman is searching for an elusive cool evening breeze on a steamy hot July 4, 1964, as turbine 12 leaves Grand Island, Nebraska, at 20 miles per hour with an eastbound extra that totals 105 cars.

T. M. Hotchkiss

The beautiful colored rock formation at Colores, Wyoming, on the western slope of Sherman Hill provides the backdrop as turbine 17 swings around the long "S" curve with an eastbound fruit train on September 27, 1960.

T. M. Hotchkiss

Number 15 rattles the depot at Echo, Utah, as it roars upgrade with an eastbound extra on September 24, 1963. The battle with Echo Canyon lies ahead for the "Big Blow", and the helper engines of the steam age are no longer available to provide assistance.



T. M. Hotchkiss

Turbine 13 charges past a massive rock formation east of Dale, Wyoming, on September 23, 1960, with an eastbound symbol manifest.

Union Pacific Railroad

Turbine 13 pulls down the lead track at Riverdale Yard in Ogden, Utah, on a beautiful morning in September 1960 with a long eastbound manifest that seemingly stretches to the distant mountains in the background.

A. J. Wolff

Double-heading of turbines was rare, but on the afternoon of June 21, 1968, numbers 14 and 30 plus two diesel units left Cheyenne on track 3 for the assault on Sherman Hill. With 21,000 horsepower at work, the westbound was soon rolling 50 miles per hour.

T. M. Hotchkiss

Under a cloud-strewn Wyoming sky, turbine 12 slowly moves east of Rock Springs with an eastbound extra of drag freight on September 21, 1960.

Turbine 19 rests forlornly silent at Sidney, Nebraska. In operation the big 8500 horsepower giants were quieter than their 4500 horsepower predecessors.

Leon Callaway

T. M. Hotchkiss

The late afternoon sunlight casts a benevolent glow on turbine 14 as it rolls a westbound stock train toward Dale, Wyoming, on September 23, 1960.

A. J. Wolff

Turbine 12 with a single diesel unit roars upgrade around the last curve on Archer Hill with an eastbound extra. Patches of snow remain on this cold morning of December 30, 1968.

R. H. Kindig

As turbine 16 arrives at Laramie on October 13, 1962, the 71 car eastbound extra passes the Pacific Fruit Express car icing facility in the process of being dismantled. At one time it was the largest such facility on the Union Pacific.

R. H. Kindig

Turbine 18 and diesels 747, 858 roll through the undulating terrain west of Medicine Bow, Wyoming, with the westbound "CLS" stock train. The 87 car hotshot is hitting 50 miles per hour and the date is May 16, 1969.

The sun has sunk low in the west as #10 with two SD-40's pulls out of Laramie, Wyoming, with a westbound extra on September 29, 1968.

A. J. Wolff

August 30, 1968. The late summer rush which customarily fills the Union Pacific with traffic is in full swing, and turbines 11 and 19 are ready at Cheyenne to do their share in moving tonnage on the famous transcontinental system.

A. J. Wolff

Turbines continued to draw "hot-shot" freight assignments during the 1968 fall rush. Number 17, in multi-unit with a single diesel unit, has started the ascent of Sherman Hill with the "CLS" on October 12, 1968. Surprisingly the stock train is leaving Cheyenne on track 4.

A. J. Wolff

A. J. Wolff

This eastbound stock train suffers from no shortage of power as turbine 13 and six diesel units power a long freight east of Cheyenne on September 5, 1968. Total horsepower is 23,600. The extra units are being transferred to meet a motive power shortage on the east end of the system.

Henry R. Griffiths

May 10, 1969, was the date of the Golden Spike Centennial festivities at Promontory, Utah, but it was business as usual for the remaining turbines in what was to be their final year of operation. Number 18 with three GP diesel units is shown arriving at Ogden, Utah, with a westbound in the early morning light of that anniversary day.

The six track turbine/diesel house at Council Bluffs was built in 1957. This scene in the early 1960's shows turbines 19 and 7, in the company of a three-unit set of U-25-B diesels headed by #638, and turbine 20 on an adjacent track.

Wm. W. Kratville

Turbine #13 is shown east of Peterson, Utah, in September 1960 with an eastbound manifest. The Wasatch Mountains with Weber Canyon are in the background, and Echo Canyon has yet to be topped.

Union Pacific Railroad

Turbine 22 faces a setting sun at Cheyenne, November 15, 1969. The locomotive was stored during the winter, ready for service, and was one of the last group of ten turbines to be retired on March 1, 1970.

James L. Ehernberger

While fleecy clouds drift lazily across a late summer sky, turbine 20 has not been lazy in lifting its westbound extra of 71 cars up Sherman Hill over the old main line on track 1. The hotshot has topped the grade at 50 miles per hour and is moving through the high speed crossover at Dale, Wyoming, on September 1, 1963.

R. H. Kindig

A. J. Wolff

Number 22 has two SD-40's to give it a helping hand, and the combo is half-way up Archer Hill with an eastbound extra on September 14, 1968.

Turbine 21 slowly moves through the yard at Cheyenne with a westbound drag on the sunny fall day of November 2, 1968.

A. J. Wolff

T. M. Hotchkiss

Tom Hotchkiss captured the drama of the bygone turbine era in this beautiful photo taken at Hermosa, Wyoming, on September 26, 1960. It was a pleasant autumn day as turbine 20 powered the eastbound upgrade toward the summit of Sherman Hill.

A. J. Wolff

Under a clear sky, turbine 25 with three diesel units rolls a long freight eastward on the Nebraska Division east of Cheyenne on September 8, 1968.

T. M. Hotchkiss

Against a backdrop of a high and rugged upland, turbine 23 swiftly powers its westbound "hotshot" toward Green River, Wyoming, on September 30, 1963. Note the fireman's friendly greeting to the photographer, a common courtesy to the professional railfan.

T. M. Hotchkiss

Turbine 24 enters east yard at Green River on October 1, 1962, with the ever present rock formations adding to this classic roster pose.

Paul R. McDonald Collection

Brand spanking new, turbine 21 is pictured October 27, 1960, at Clinton, Iowa, on the Chicago & North Western Railroad, enroute to Council Bluffs for delivery to the Union Pacific.

Gordon Glattenberg

The eastern slope of Cajon Pass near Frost, California, is the site of this mid 1962 photo of turbine 29 on a westbound. The scenery west of Victorville includes the unusual shaped Joshua tree and other strange flora found in the desert. Equally as strange in the power consist behind the Big Blow is the EMD test car, GP-30 demonstrator 5629 and two U.P. SD-24's.

As downy soft clouds drift across the Wyoming sky, turbine 21 roars upgrade at 50 miles per hour on Sherman Hill's track 3 near Lynch with an 84 car westbound extra on September 16, 1961.

R. H. Kindig

X-22 West has pulled through the Cheyenne yard and is ready to start the assault on fabled Sherman Hill.

Leon Callaway

X-27 West heads out of Cheyenne under a familiar landmark, the signal bridge at the west end of the yard. The locomotive combination of a turbine and two diesels is moving without a trace of smoke in this scene of December 29, 1968.

A. J. Wolff

Richard Steinheimer, Everett L. DeGolyer Library

"Big Blow" 23 howls its way upgrade out of Rock River, Wyoming, as the eastbound manifest heads across the snow sprinkled landscape. The turbine era had several years remaining and the 23 would see service until the end.

R. H. Kindig

The motive power combination of turbine 28 and GP-9's 317-B and 312-B pulls into Cheyenne, Wyoming, with a westbound extra of 88 cars on May 18, 1963.

T. M. Hotchkiss

The Union Pacific crosses the Continental Divide at Creston, Wyoming, 29 miles west of Rawlins, Wyoming, at an elevation of only 7,104 feet on a hardly noticeable grade of 0.82%. Turbine 25 moves across the Divide with this eastbound on September 27, 1963.

Chard Walker

The San Bernardino Range is the rock laden barrier between Southern California and the east. For a few months in the summer of 1962, the turbines had their chance to do battle with the steep grades of Cajon Pass. Number 25, in the company of two SD-24's, is making its first trip eastbound on July 19 and is shown at Sullivan's Curve.

Posing side by side, turbine 26 and a four unit set of diesels headed by the 1404 await entry into the Cheyenne yard from the west. When the eastbound fleet is bunched together as it was on October 19, 1968, the holding pattern is a common sight.

A. J. Wolff

R. H. Kindig photo, Paul R. McDonald Collection

With turbine 23 and GP-9 144B on the point, this caboose hop appears to be the world's most over powered train. The power transfer is moving 40 miles per hour near Wycon, Wyoming, on the old Sherman Hill main line. The date is September 2, 1969, and the remaining turbines have less than four months of operation left.

A. J. Wolff

Number 30, last of the gas turbines, easily handles this eastbound on a warm August 4, 1968, as the manifest swings around the north end of the long "S" curve on Archer Hill east of Cheyenne.

Turbine 26 had long since made its last run as it awaited final disposition at Cheyenne on May 25, 1973. Numbers 26 and 29 were the last turbines to leave Cheyenne and were moved east in September 1974.

Thos. R. Lee

Thos. R. Lee

Turbine 29, minus its tender, is facing the early morning sun outside the Cheyenne shops on May 29, 1970. Although the giant had received minor repairs during the winter, it would never run again.

A. J. Wolff

Turbine 28 with two SD-40 diesels is shown barreling out of Laramie, Wyoming, with the westbound "CLS" stock train in the late afternoon of September 18, 1968.

T. M. Hotchkiss

This is it—Union Pacific's crossing of the nation's backbone! Turbine 30 leads a westbound extra across the crest of the continent at Creston, Wyoming, on September 27, 1963.

Both photos by Steve Harris

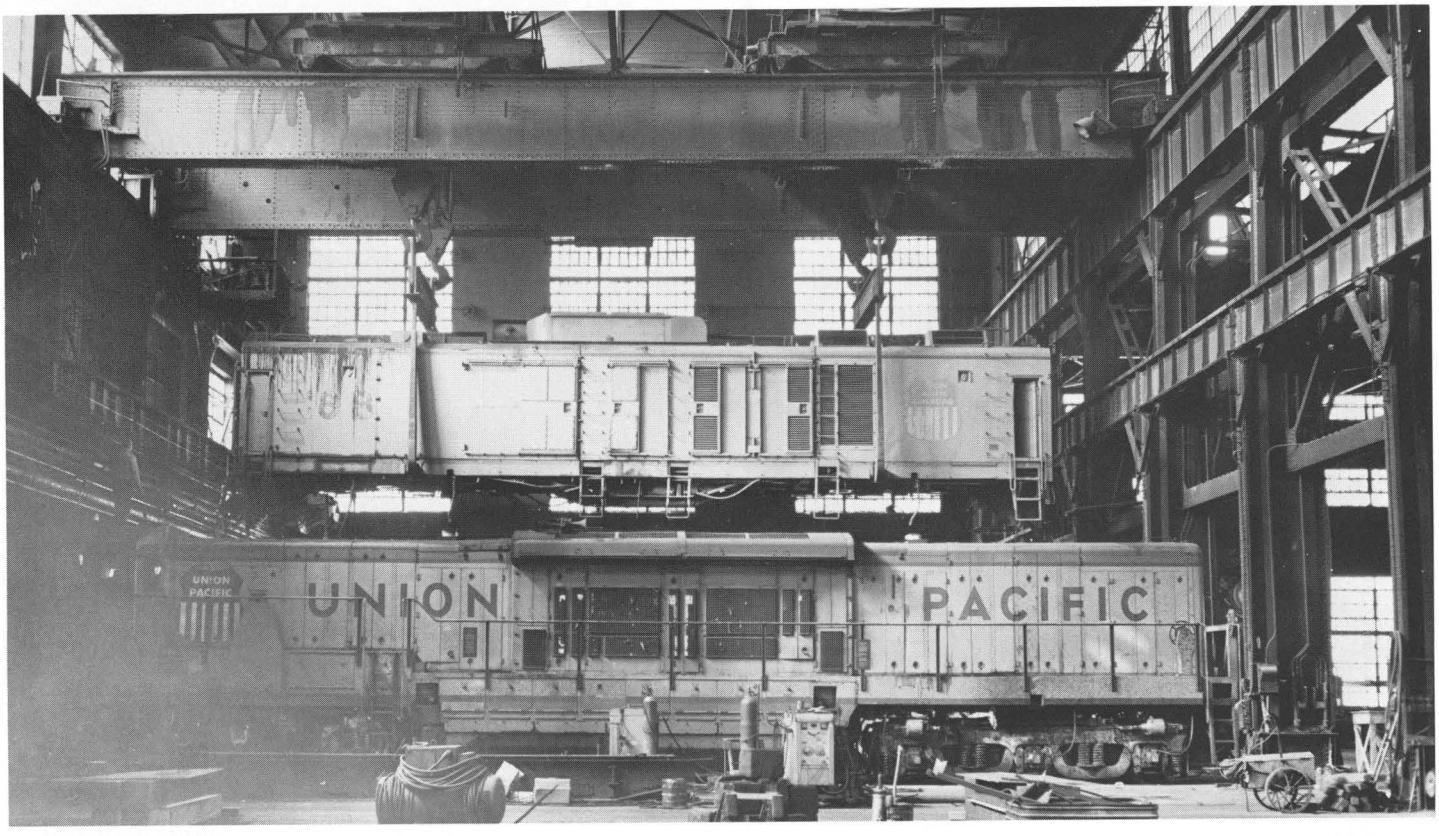
The pedestrian overpass at Green River, Wyoming, is a good spot for railfans to watch the busy mainline action of the U.P. from. On July 25, 1963, turbine 25 was handling a westbound empty reefer drag of 130 cars past the huge depot. Five cars back, another turbine, #29, was visible—dead in train—destined for the Salt Lake City shops for repairs.

Henry R. Griffiths

With some of the multi-colored rock formations of Echo Canyon at its side, turbine 29 with two 400 class SD-24 diesels nears Castle Rock, Utah, with an eastbound in July 1965.

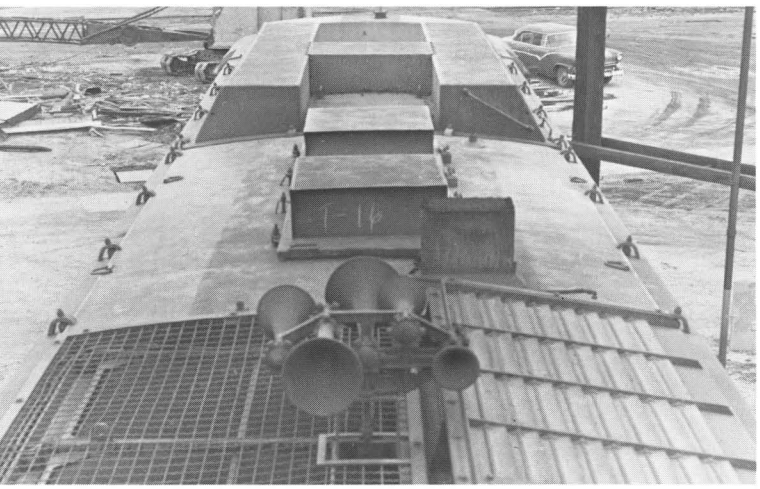
A. J. Wolff

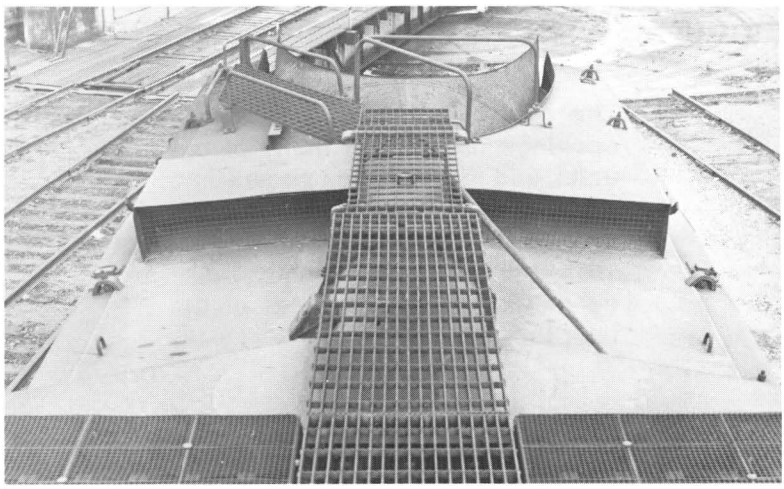
In their last year of operation, Cheyenne, Wyoming, became the "home base" for the remaining turbines. This scene outside the shops at "CHIAN" of turbine 8 and diesels 808 and 707 appears normal enough, but the date is October 11, 1970, and number 8, one of ten remaining serviceable turbines at that time, is patiently waiting for a 1970 call to duty that never came.



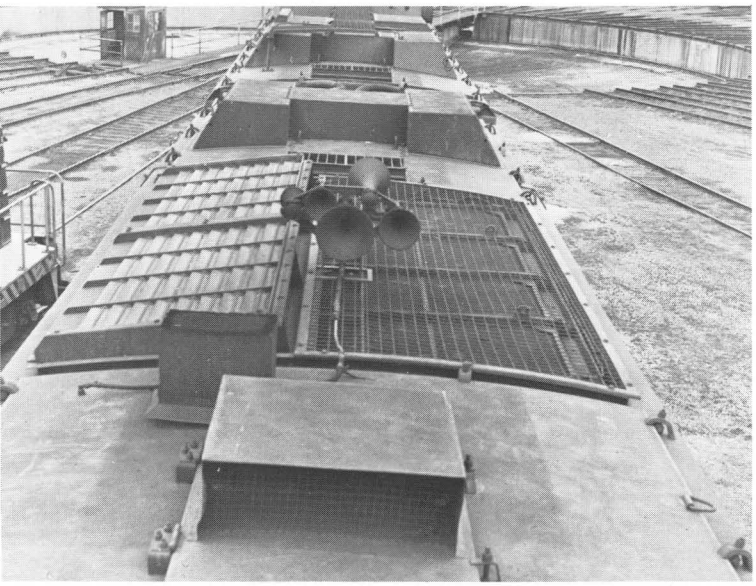
A. J. Wolff

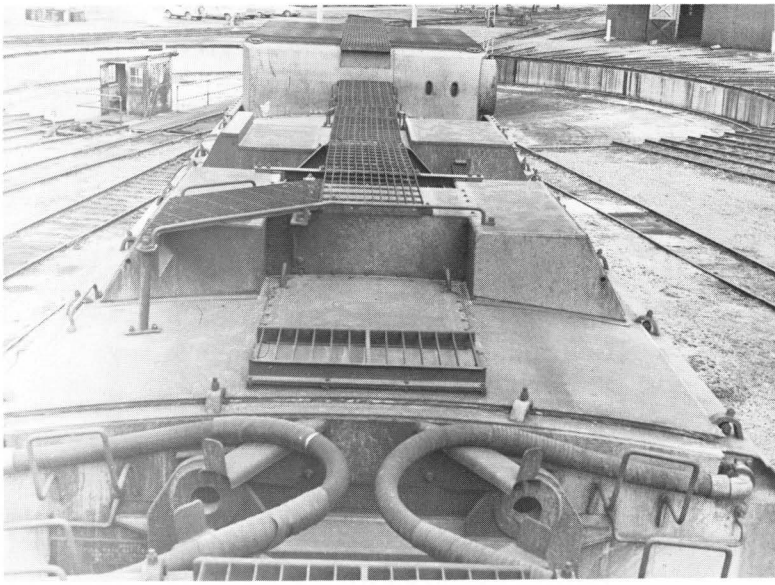
Few spectacles in railroad life are more dramatic than a shop scene such as this. On March 5, 1972, turbine unit 18B, long since retired, was moved into the back shop at Cheyenne. The front ex-turbine trucks on U-50-C diesels #5002 and 5028 had proved defective, and the trucks from the 18B were used as replacements.





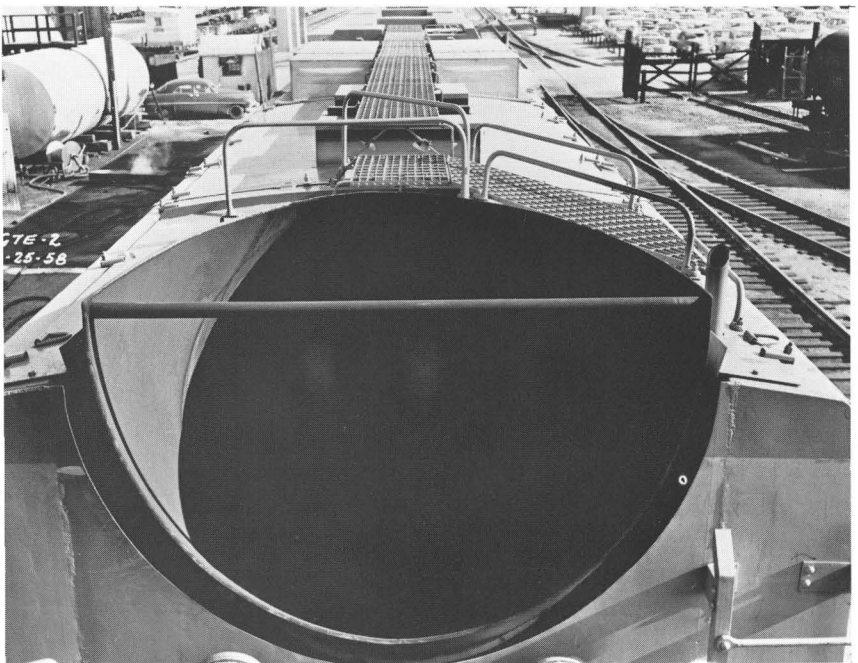
These photos show the roof detail of an 8500 horsepower gas turbine. (Top left) The horns were originally located on the cab roof but icing problems in cold weather dictated their movement to the diesel radiator behind the auxiliary diesel exhaust, shown slightly to the right. Looking forward, the two raised rectangular boxes are engine room air intakes, while the H-shaped boxy construction is part of the dynamic brake resistor cooling system. (Middle left) Looking to the rear, one sees the diesel radiator and the second dynamic brake housing unit. (Middle right) The B unit possessed another set of dynamic brake ventilation housings, followed by the gas turbine air intake and silencer. (Top right) Next were the engine room air intakes and (bottom photos) the turbine exhaust casing.

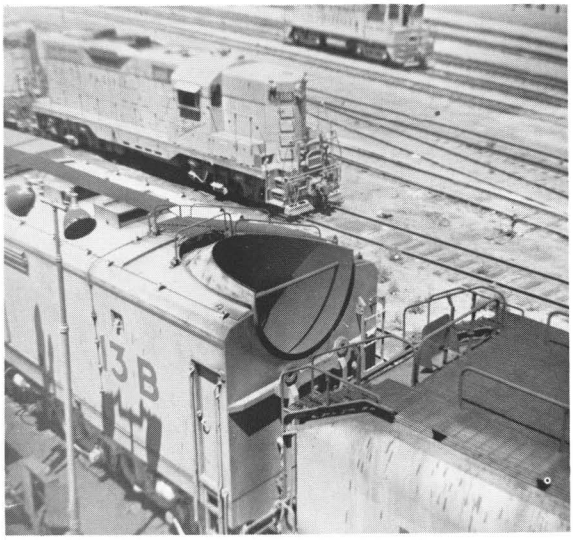




Four above photos by D. J. Rands

Photo below from Union Pacific Railroad



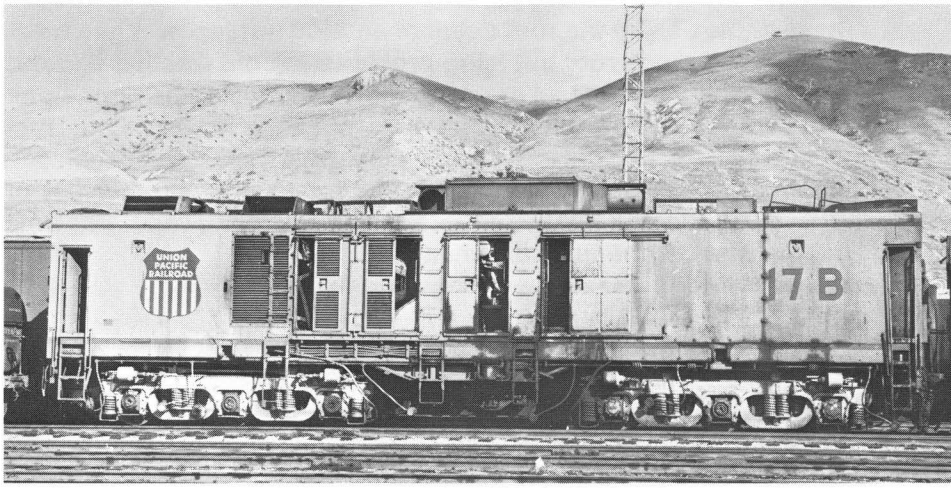


Steve Harris

The roof details and ventilation openings differed on many of the units, and these photos show some of those differences on the B units. The 1B, at Cheyenne on July 12, 1964, had a larger dynamic brake ventilation area than most of the later units did.

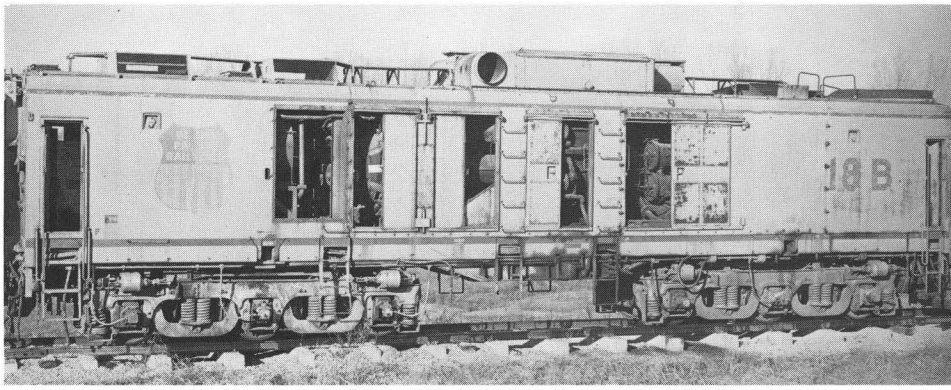
J. L. Ozment

The 17B, shown at Salt Lake City on November 1, 1969, and the 18B, at Riverside, Missouri, near Kansas City on January 23, 1976, had double openings rather than the full arrangement. The only unit known to have a front "dog house" added was the 28B, also shown at Riverside October 27, 1975.

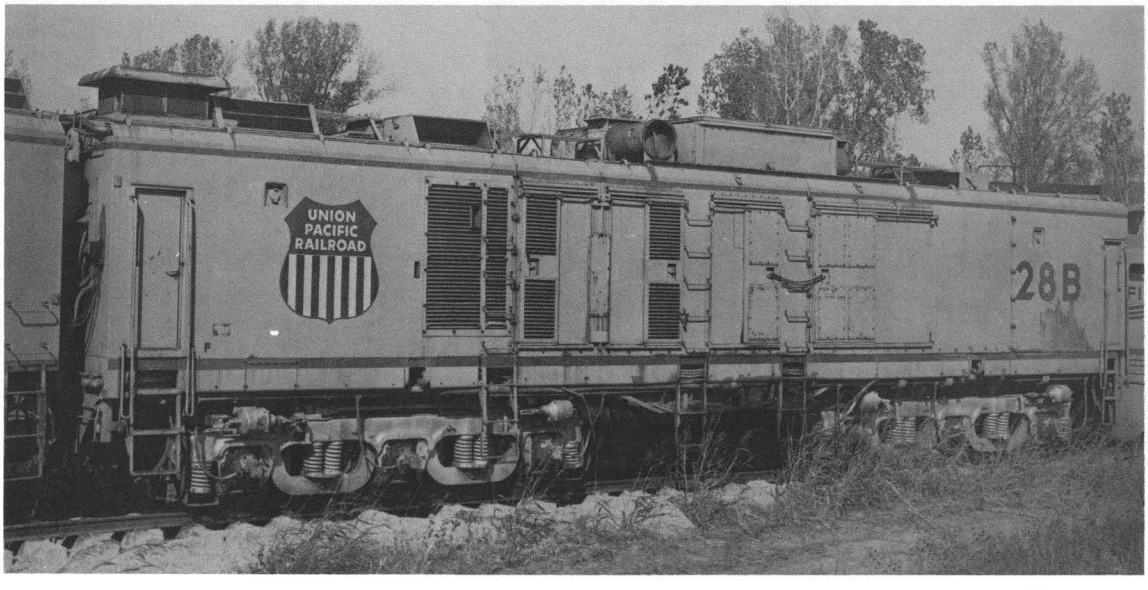


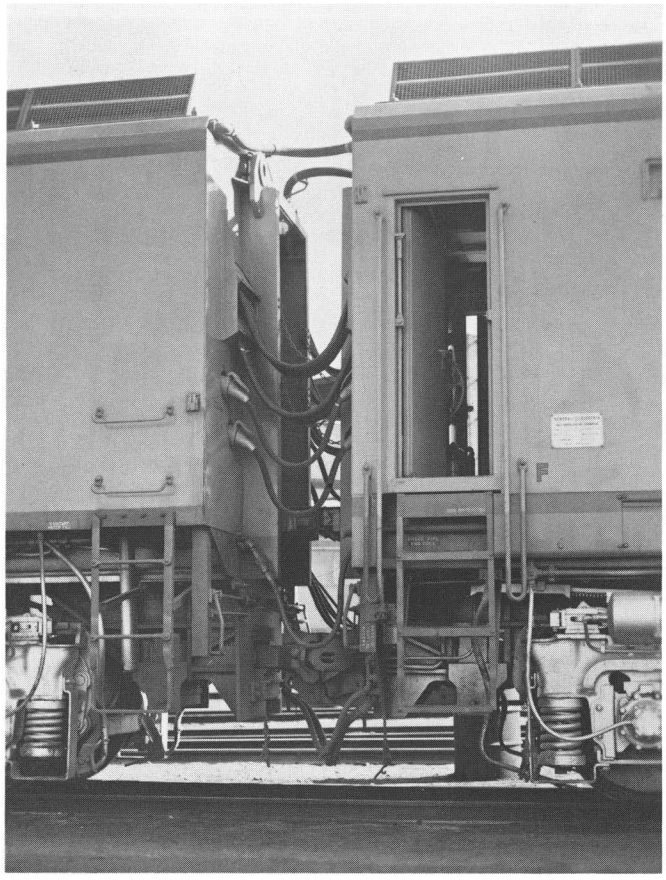
J. L. Ozment

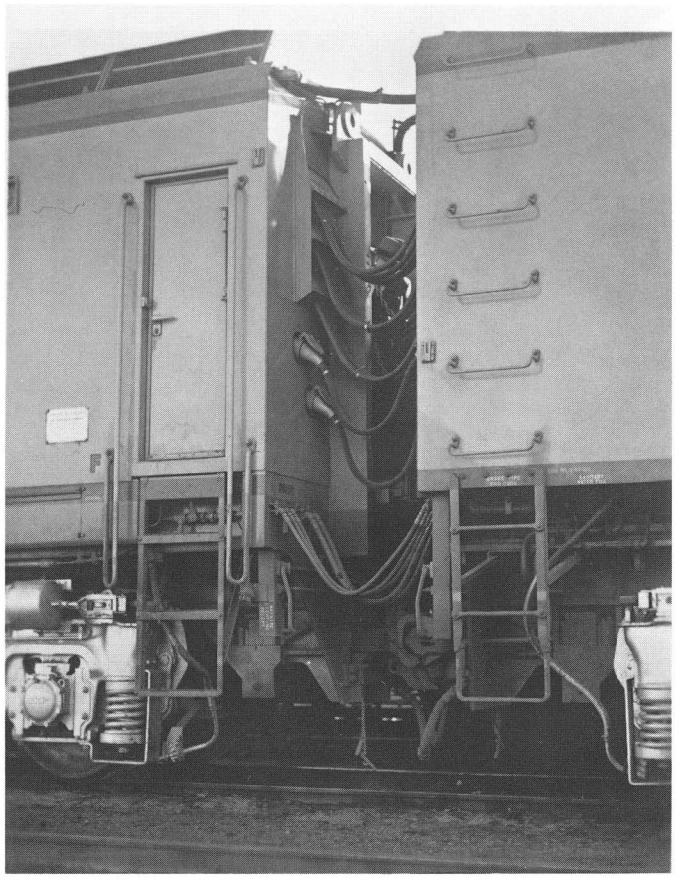
The interior arrangement of the B unit components are also visible in the photos with the access doors open. The top photo shows the turbine ignition chambers at the rear door. In the middle of the unit is the turbine reduction gear box, while one of the two traction generators is visible through the front set of doors on the 18B.



Both photos by George R. Cockle

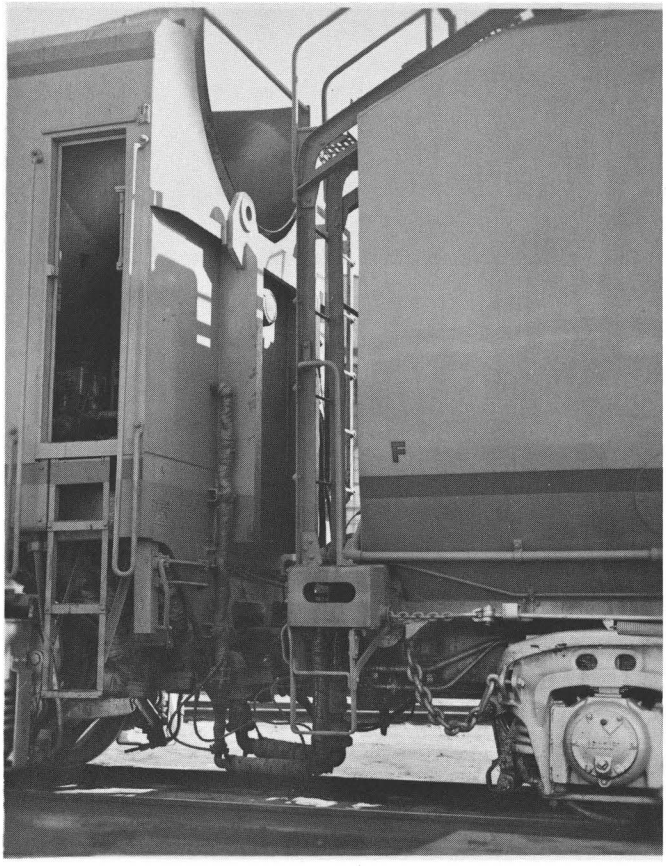






Both photos by Allan Krieg

Type "F" tight-lock couplers were used to semi-permanently connect the A and B units of the 8500 horsepower gas turbines. The profusion of control cables between the units is pictured above, showing both sides. The two photos below show the exhaust opening at the rear of the "B" unit and the fuel oil and control connections to the fuel tender.



Allan Krieg

Union Pacific Railroad

Thos. R. Lee

The cab control unit of #80 was originally the 607, a 2000 horsepower PA-1 passenger diesel built by Alco in January 1949. For several years the 607, 607-B were assigned to the Kansas Division for handling such trains as #70, the eastbound local, shown leaving Manhattan, Kansas, on May 14, 1955.

Coal turbine 80 is preparing to leave the Omaha yard, October 17, 1962, on its first revenue trip.

Wm. W. Kratville

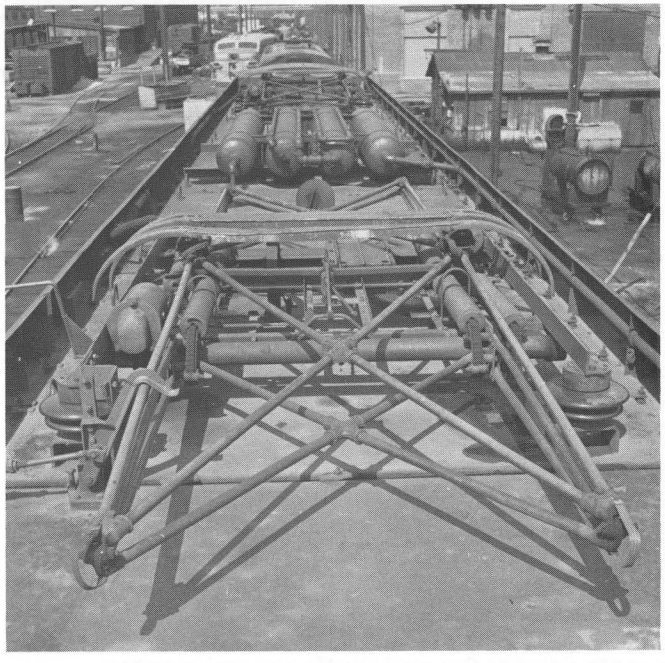
Wm. W. Kratville

Great Northern electric #5019 is shown in this General Electric builder's photo taken June 23, 1947. Sister locomotive #5018 was purchased by the Union Pacific twelve years later.

J. A. Rutherglen Collection

Wm. W. Kratville

Wm. W. Kratville



Wm. W. Kratville

Ex-Great Northern electric #5018 arrived at Omaha in September 1959. The big 5000 horsepower unit had been retired in 1956 when G.N. electrified territory was eliminated. The locomotive arrived on U.P. property with roof pantographs intact, a fact that is interesting when some sixteen years later the historic road is conducting experiments toward possible electrification of parts of the system.

Wm. W. Kratville

(Above) The world's only coal burning gas turbine electric locomotive is passing the long PFE icing dock at Council Bluffs on track 3 enroute to Grand Island on its first trip. The two GP-9's, headed by #339, are for protection power only.
(Right) Number 80, with the usual diesel protection power, heads an empty reefer drag westward out of Omaha in 1963. The coal turbine made many test trips in revenue service during that year.

Wm. W. Kratville

Wm. W. Kratville

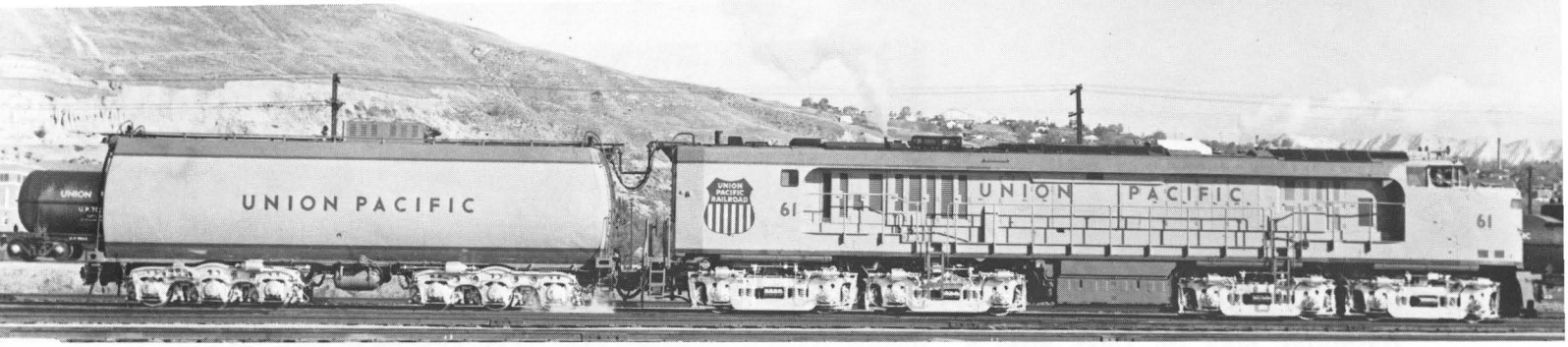
Renumbered 8080 in April 1964, the coal turbine rests dead at Council Bluffs several months later. It never ran again.

The coal burning gas turbine is pictured on the wye at Cheyenne, Wyoming, May 18, 1963, after a westbound test run.

Number 80 made several test runs to the Wyoming Capitol city in 1963, and Dick Kindig recorded the experimental locomotive on September 28 of that year, after arrival on a westbound freight earlier in the morning.

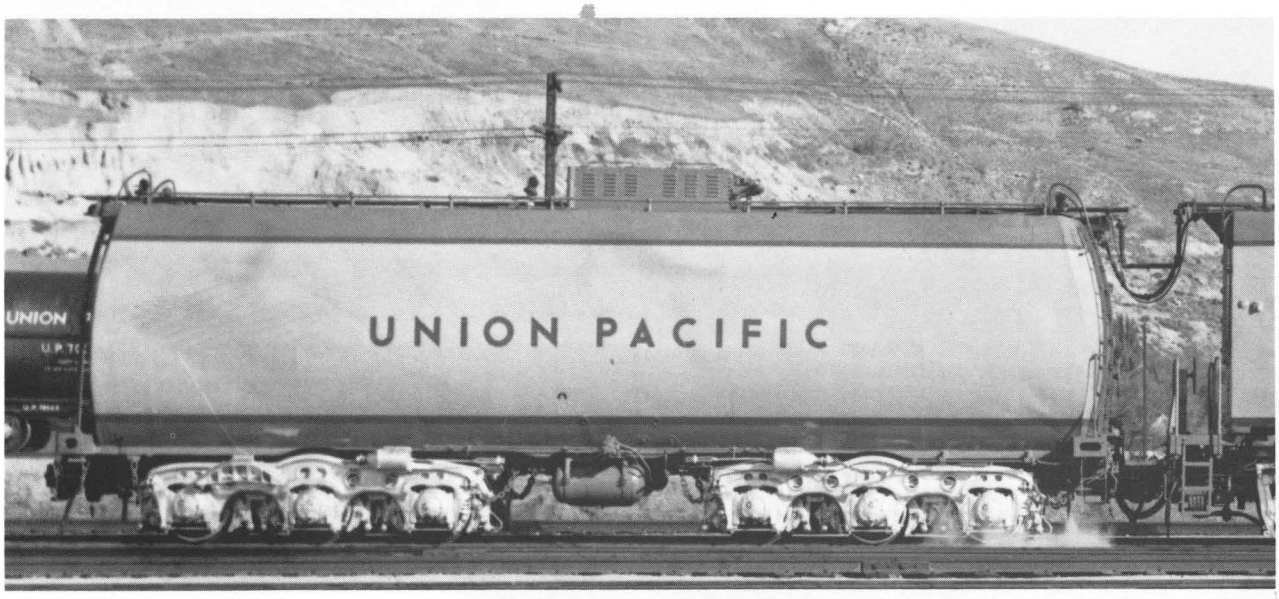
The 80B had much of the screened side paneling removed during the 1963 tests, and the unit retained little of the original look of G.N. #5018.

All photos on this page by R. H. Kindig



Union Pacific Railroad

The first 4500 horsepower turbine to receive an auxiliary fuel tender was #61, pictured at Salt Lake City, November 1, 1955, when the tender was first added for tests. The tender (below) came from the first scrapped 4-8-4 steamer, the 806, and was rebuilt with the installation of a sheet metal face at the oil bunker end to make both ends conform in design.



J. L. Ozment

Later tenders for the 4500 horsepower turbines were built by using the running gear and frames from ex-9000 class steam locomotive tenders and splicing the water compartments from two tenders back to back on a single frame. Turbine 62, with one of the rebuilt ex-9000 tenders, is shown entering the Cheyenne yard with an eastbound on September 21, 1958.

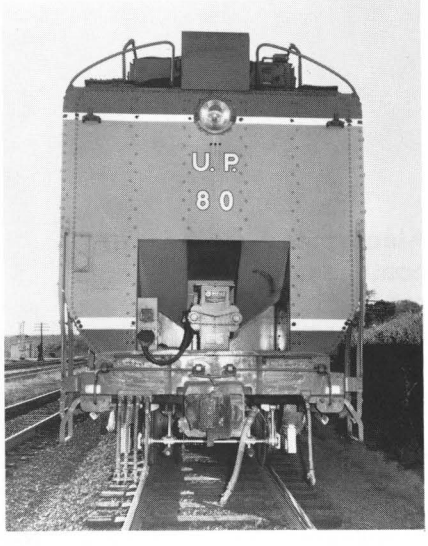
Union Pacific Railroad

Most of the 24,384 gallon fuel tenders for the 8500 horsepower turbines were built from retired 800 class steam engine tenders. They were insulated with four inches of glass wool and contained heating elements (note the six circular access plates) in order to retain the heat of the fuel oil which was preheated in a range from 135° to 180° Fahrenheit when placed aboard.

Union Pacific Railroad

The last turbine fuel tender built by the Union Pacific was the ex-3990 steam tender which was refitted for use as the tender for coal burning gas turbine electric locomotive #80. This photo was taken at Omaha on June 23, 1961, when rebuilding of the tender was completed. Note the difference in appearance between the left side and right side of the tender.

Wm. W. Kratville



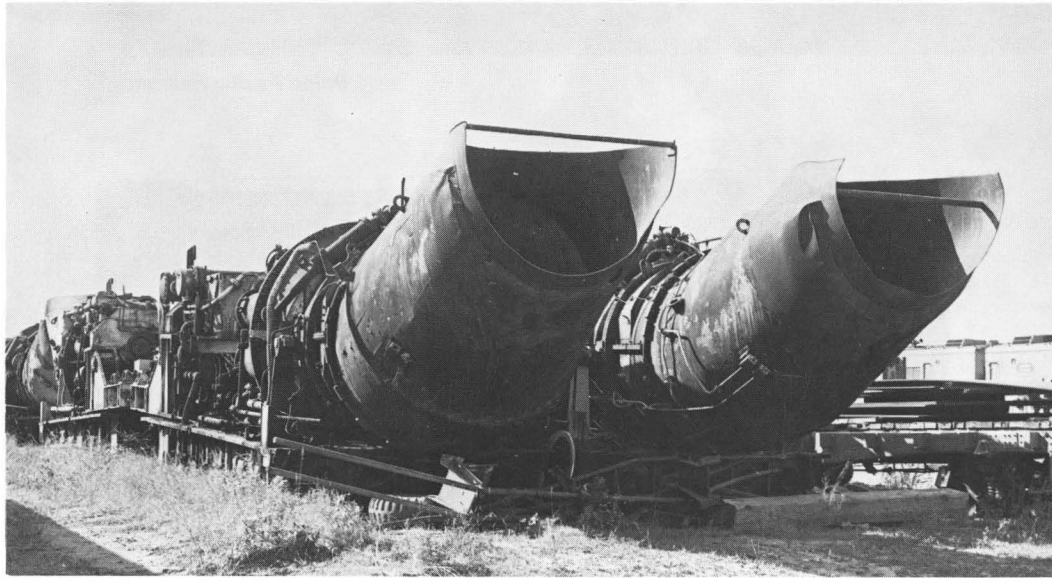
Thos. R. Lee

While none of the big two-unit locomotives ever ran to Kansas City in revenue service, six of them—a full 20% of the fleet—were stored at the Intercontinental Engineering Co. plant near North Kansas City, Missouri, for over two years. Turbines 8, 7, 29, 26, 28, and 18 were lined up on October 24, 1975, awaiting final disposition.

Turbine 18 was the last in line on the storage track. When switching movement of any of the units was necessary, the cab unit of #18 took on a new role as switcher, for the 850 horsepower Cooper-Bessemer diesel engine was still capable of performing work. Hope still remains that this unit may be preserved for the Kansas City Railroad Museum.

George R. Cockle

Also stored at the Intercontinental plant were eight other gas turbine engines, reportedly destined for barge duty in South America.

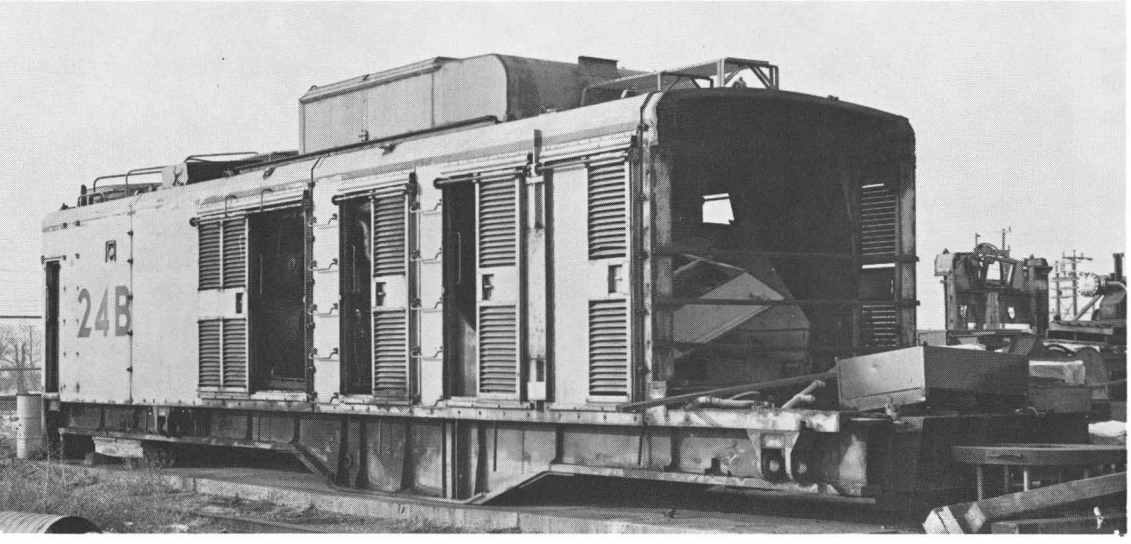


George R. Cockle

As 1975 drew to a close, the cab units of turbines 14 and 16 remained intact on U.P. property at Salt Lake City. They were being stored for owner G. F. Bean Co. of New Orleans. (Right) This photo taken December 18, 1975, shows the roof detail of #14, minus horns. (Middle) Otherwise both units are in relatively good condition as they appeared two months earlier in the company of two EMD switchers.

George R. Cockle

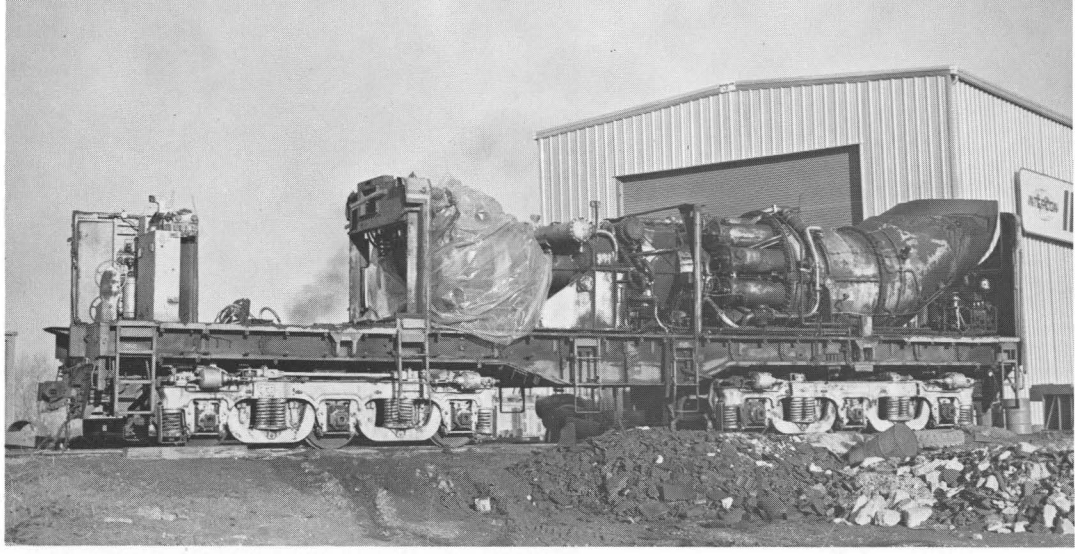
Steven W. Belmont



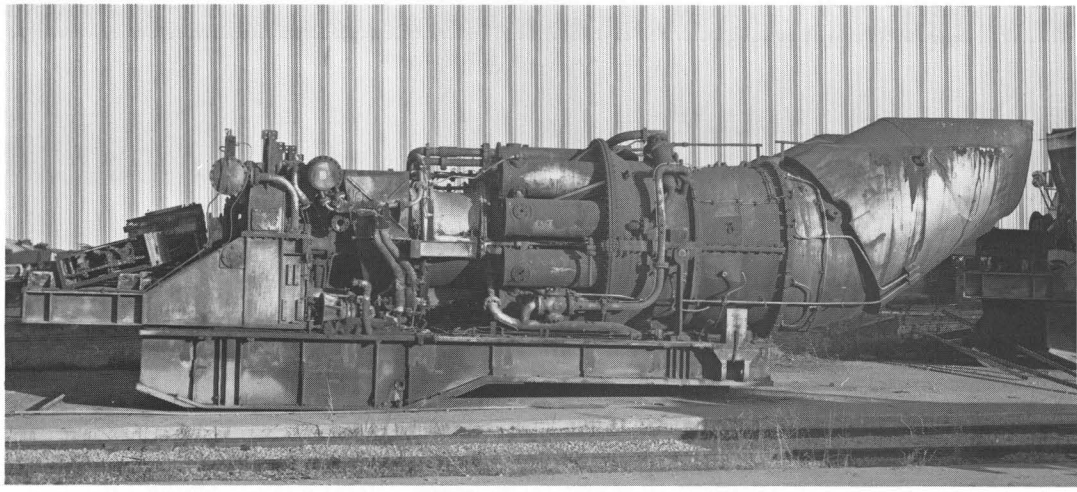
George R. Cockle

At General Electric's Salt Lake City service shop, the partial carbodies and frames of turbine units 24B and 9B (right background) remain as in this photo taken December 18, 1975.

1976 produced a different picture for the turbines at Intercontinental, however. (Right) In a photo taken January 23, 1976, the position of the turbine prime mover on the frame clearly shows as the carbody shell has been cut away on a "B" unit. (Middle) Another of the "B" units had already been scrapped down to the frame holding the turbine engine.



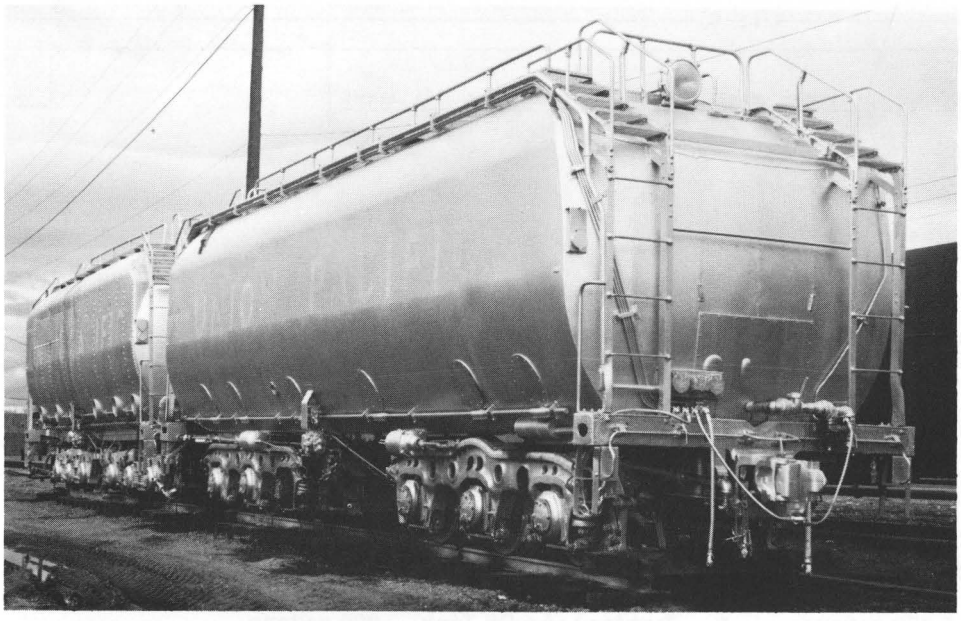
George R. Cockle

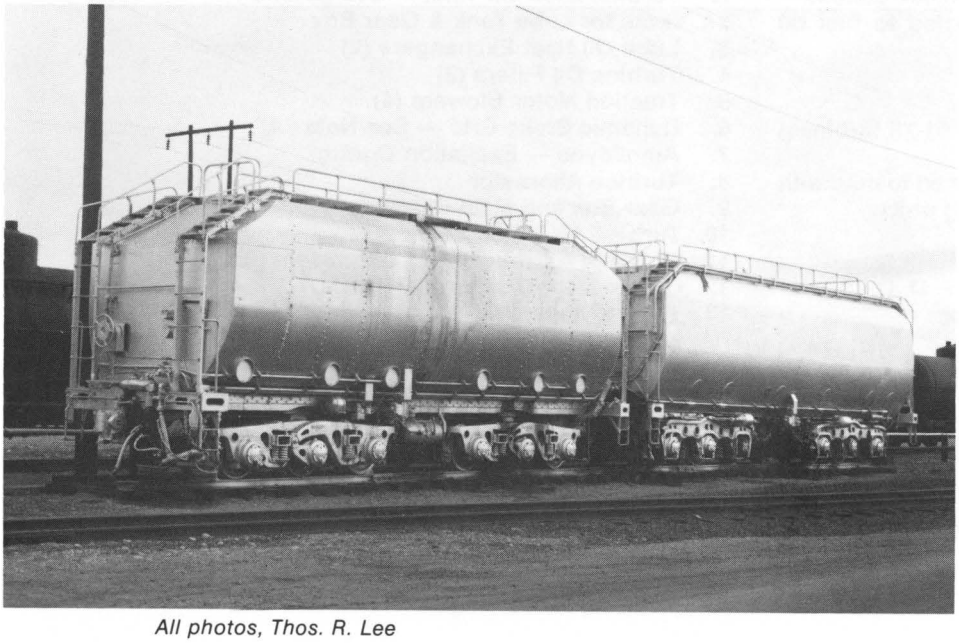


George R. Cockle

Elsewhere in the yard on January 23, 1976, workmen were removing the diesel fuel tank and battery box on turbine 7. Most, if not all, of the remaining units were to be scrapped by spring.

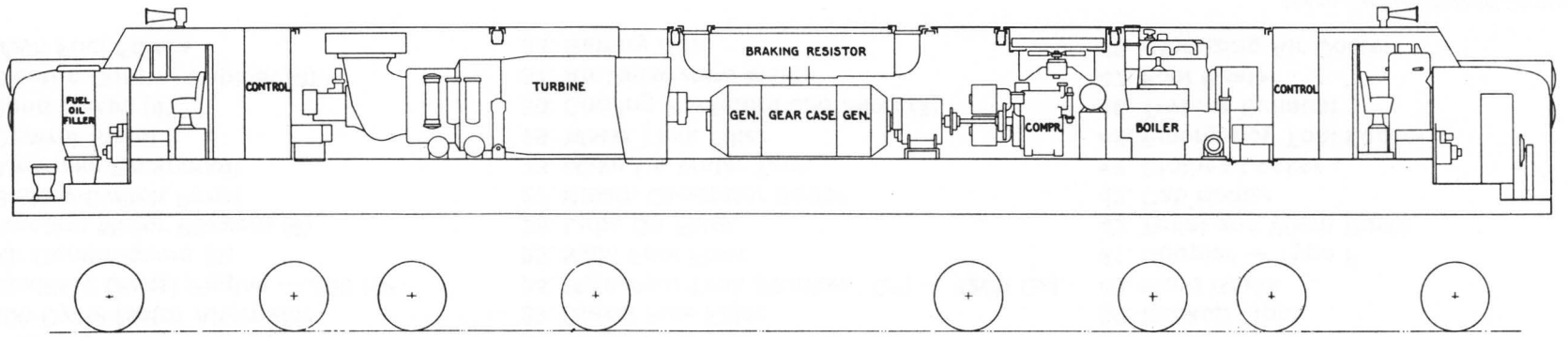
George R. Cockle

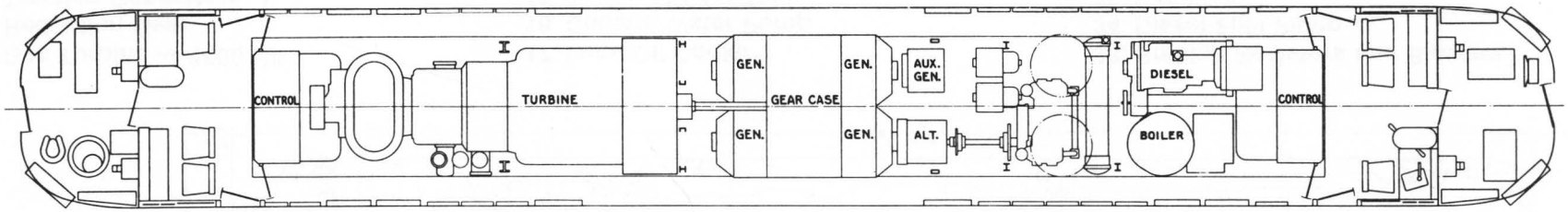


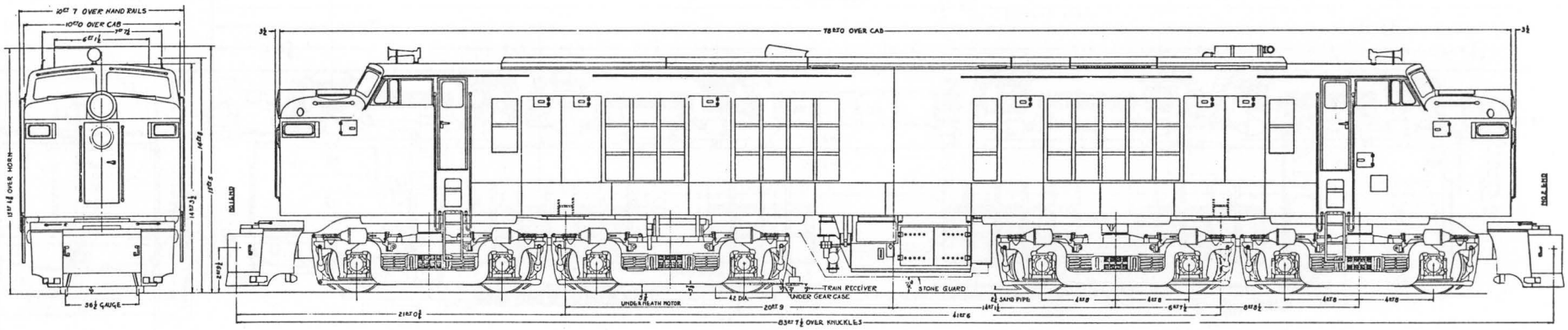


All photos, Thos. R. Lee

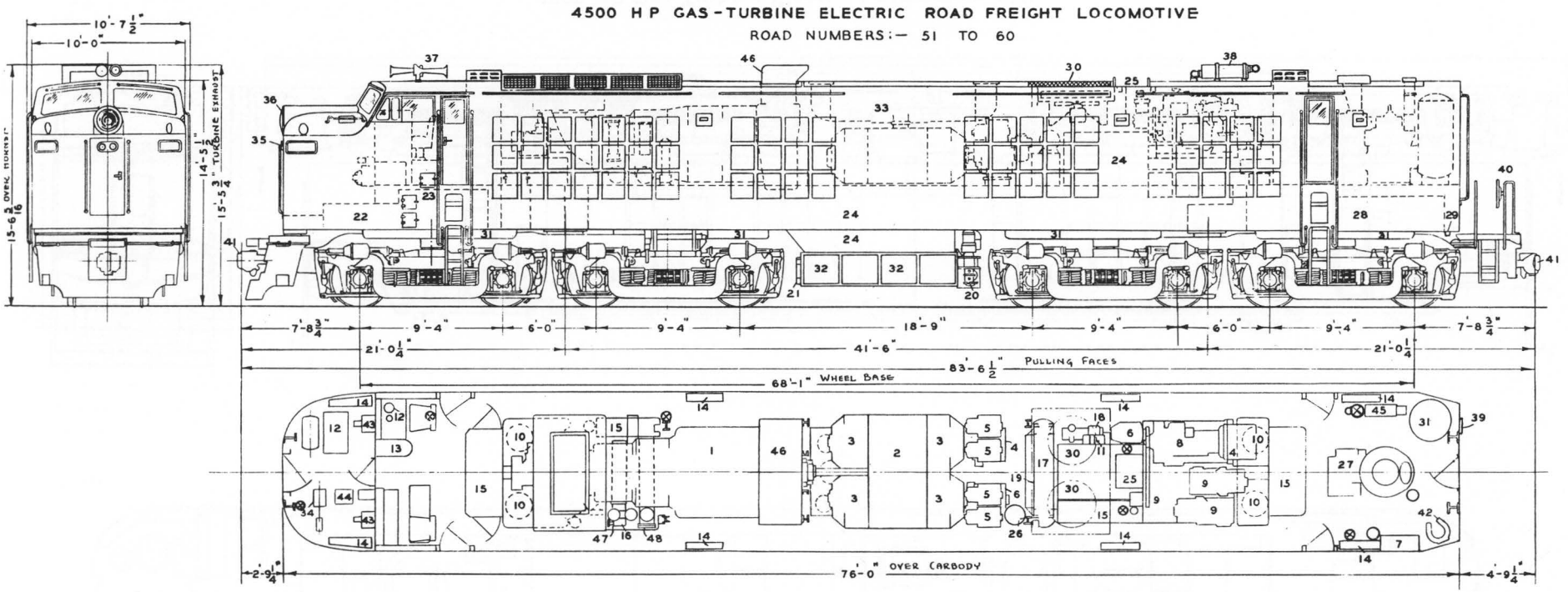
Although the gas turbines are gone from service, many of the fuel tenders remain as fuel storage tanks at various points on the system. These three photos of two such ex-turbine tenders were taken on May 12, 1975, at Riverdale Yard in Ogden, Utah. The tenders, repainted silver, are located on a stub track near the engine facilities at the south end of the yard. The tenders for the 8500 horsepower turbines were rebuilt from retired 800 class and 3800 class steam engine tenders. Both types are pictured here, the 800 class tender on the right, and the 3800 class tender on the left. The differences in size, general appearance, trucks, and side rod heating elements are easily distinguishable. The ex-3800 class tender was the fuel tender for turbine #28, and was later renumbered 903033 when assigned to Maintenance of Way service. The ex-800 class tender was used on turbines 26 and 21 at different times as the same tender did not always remain with the same turbine during its entire service life. When transferred to M of W, it became #903034.





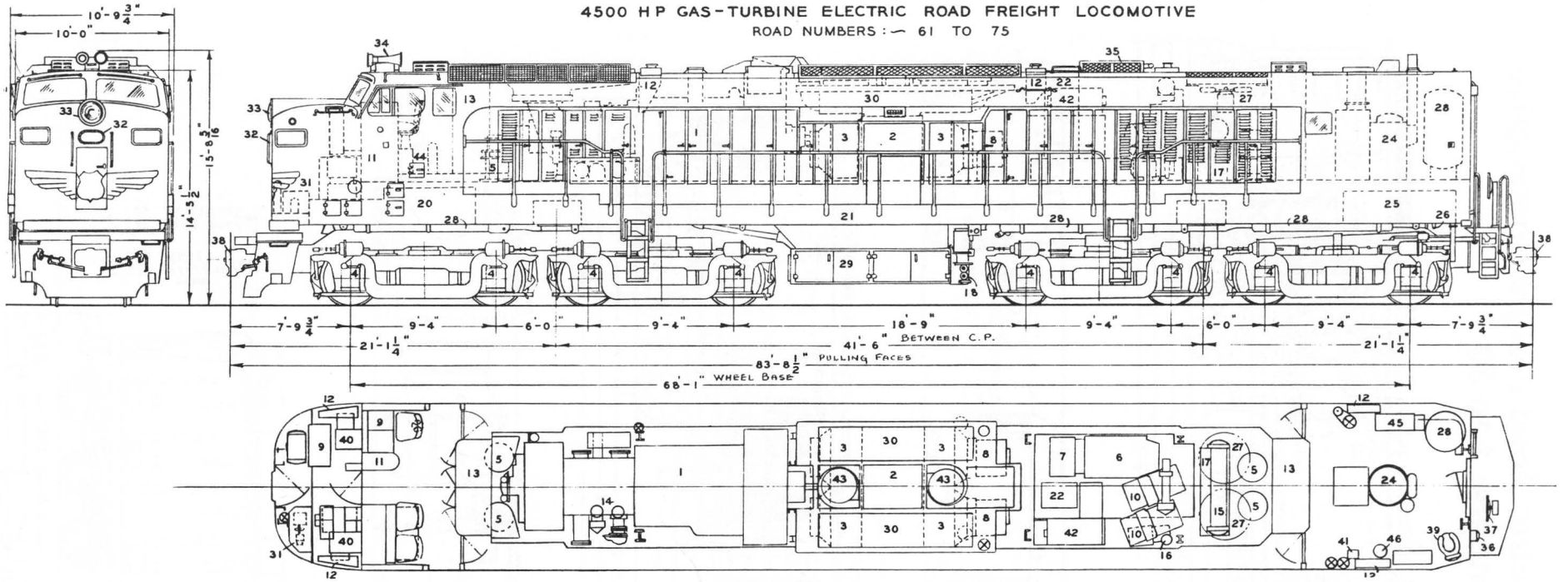


4500 HP Gas Turbine Electric Locomotive #50



1. Gas Turbine — 4500 HP
2. Reduction Gear
3. Traction Generators (4)
4. Auxiliary Generators (2)
5. Amplidyne Exciters (4)
6. Auxiliary Alternators (2)
7. 400 Cycle Motor Alternator
8. Auxiliary Diesel Engine — 250 HP
9. Air Compressors (3)
10. Traction Motor Blowers (4)
11. Battery Switch Panel
12. Air Brake Equipment
13. Control Stand
14. Sand Boxes (4)
15. Electric Control Cabinet (4)
16. Main Fuel Filters
17. Lube Oil Cooler
18. Coolant Water Pump
19. Coolant Water Tank
20. Main Fuel Pump
21. Lube Oil Tank
22. Diesel Fuel Tank — 1000 Gal.
23. Diesel Fuel Filler
24. Main Fuel Tank (Bunker "C") — 7200 Gal.
25. Main Fuel Filler
26. Lube Oil Filter
27. Steam Generator Boiler
28. Make Up Water Tank
29. Water Tank Filler
30. Cooling Radiators and Fans (2)
31. Air Reservoirs Main
32. Battery Box
33. Braking Resistors and Blowers
34. Diesel Fuel Pump
35. Headlight
36. Oscillating Signal Light
37. Horn
38. Diesel Muffler
39. Backup Light
40. Hand Brake
41. Coupler — Type F
42. Toilet and Wash Basin
43. Cab Heater
44. Clothes Locker
45. Emergency Tool Locker
46. Turbine Exhaust
47. Fuel Heater
48. Atomizing Air Cooler

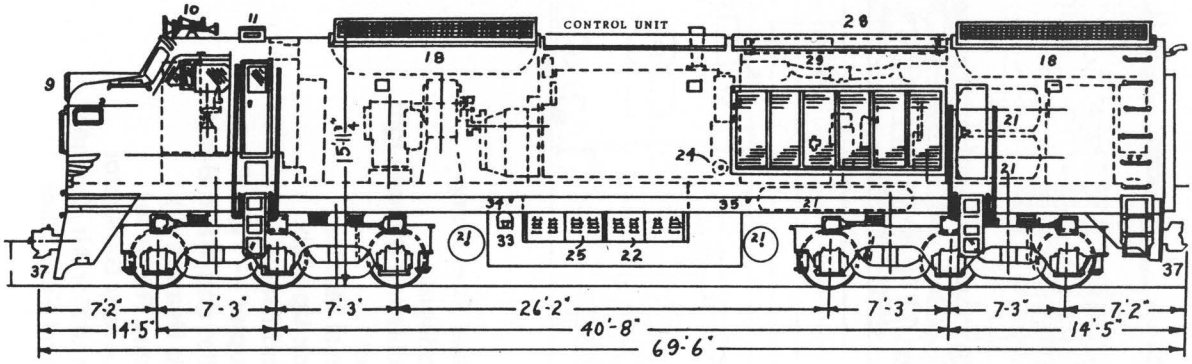
Union Pacific Railroad Company
Research and Mechanical Standards

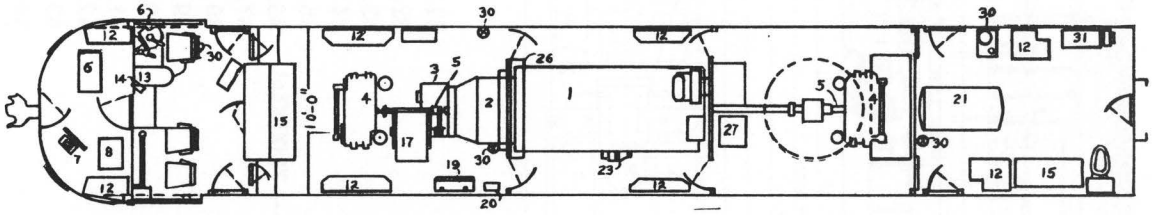


1. Gas Turbine — 4500 HP
2. Reduction Gear
3. Traction Generators (4)
4. Traction Motors (8)
5. Traction Motor Blowers (4)
6. Diesel Engine — 250 HP
7. Diesel Alternator & Generator
8. Auxiliary Alternators (2)
9. Air Brake Equipment
10. Air Compressor
11. Control Stand
12. Sand Boxes (4)
13. Electric Control Cabinet
14. Main Fuel Strainer
15. Lube Oil Cooler
16. Coolant Water Pump
17. Coolant Water Tank
18. Main Fuel Pump
19. Lube Oil Tank
20. Diesel Fuel Tank — 1000 Gal.
21. Main Fuel Tank (Bunker "C") — 7200 Gal.
22. Main Fuel Filler
23. Lube Oil Filter
24. Steam Generator Boiler
25. Make Up Water Tank
26. Water Tank Filler
27. Cooling Radiators and Fans
28. Air Reservoirs
29. Battery Box
30. Braking Resistors & Blowers
31. Diesel Fuel Pump
32. Headlight
33. Oscillating Signal Light
34. Horn
35. Diesel Muffler
36. Back Up Light
37. Hand Brake
38. Coupler — Type F
39. Toilet and Wash Basin
40. Cab Heaters (2)
41. Speed Recorder
42. Auxiliary Generator
43. Generator Air Cleaner
44. Diesel Fuel Filler

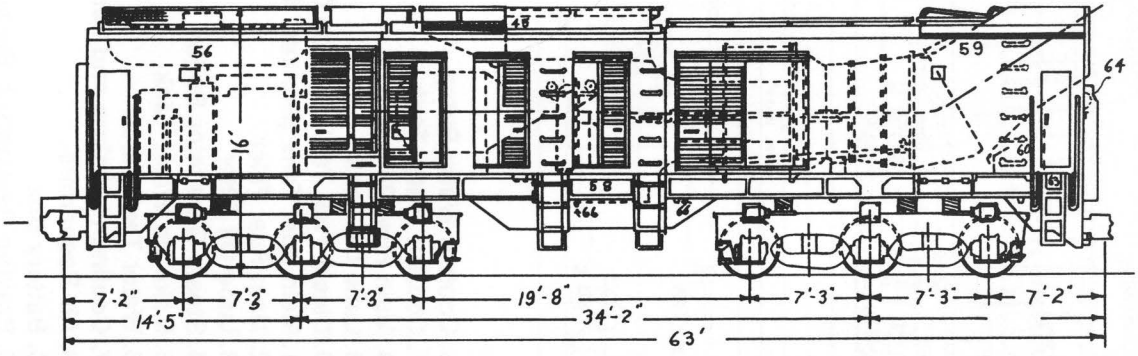
Union Pacific Railroad Company
Research and Mechanical Standards

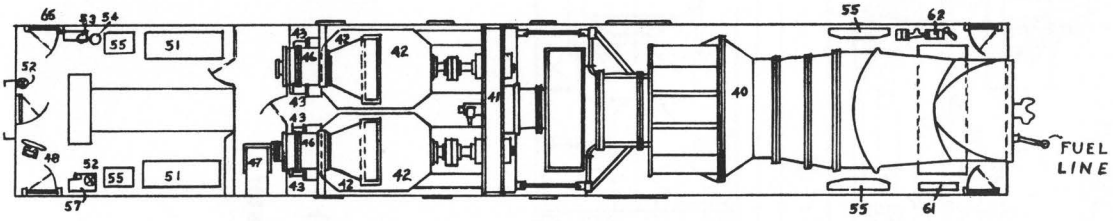
8500 H P Gas-Turbine Electric Road Freight Locomotive
Road Numbers: 1 to 30



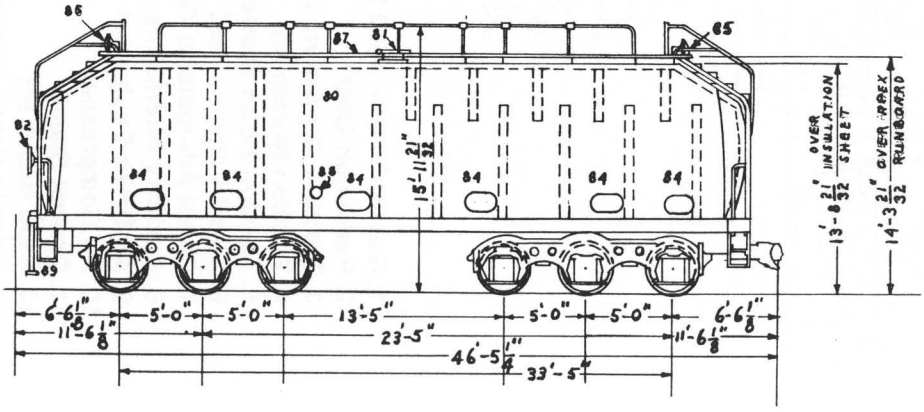


TURBINE UNIT





24,000 GALLON FUEL OIL TENDER



EQUIPMENT
CONTROL UNIT

1. Auxiliary Diesel Engine — 850 HP
2. Diesel Generator
3. Auxiliary Generator
4. Air Compressors (2)
5. Quick Disconnect Couplings
6. Air Brake Equipment
7. Hand Brake
8. Automatic Cab Signal
9. Headlight
10. Horn
11. Cab Heater
12. Sand Boxes (8) — Total 120 cu. ft.
13. Control Stand
14. Speed Recorder
15. Propulsion Control (2)
16. Auxiliary Control
17. Traction Motor Blower
18. Dynamic Braking Resistor
19. Wheel Slip Control
20. Engine Start Panel
21. Main Reservoirs
22. Diesel Fuel Tank — 2500 Gal.
23. Diesel Engine Fuel Pump
24. Turbine Start Fuel Pump
25. Batteries
26. Diesel Water Tank — 70 Gal.
27. Turbine Water Tank — 82 Gal.
28. Radiator
29. Radiator Fan — 72"
30. Fire Extinguishers
31. Emergency Tool Locker
32. Toilet
33. Diesel Fuel Filler
34. Diesel Water Filler
35. Turbine Water Filler
36. Traction Motors (6)
37. Coupler — Type F

EQUIPMENT
FUEL TENDER

80. Bunker "C" Fuel Oil Tank — 24,384 Gal.
81. Fuel Fill
82. Hand Brake
83. Wayside Steam Coils
84. Electric Heating Elements (12)
85. Back Up Light
86. Air Brake Equipment
87. Fuel Level Gauge — Dipstick
88. Fuel Pipe

Tender Wheels 36" Diameter

EQUIPMENT
TURBINE UNIT

40. Gas Turbine — 8500 HP
41. Reduction Gear
42. Traction Generators (2)
43. Exciters (4)
44. Traction Motors (6)
45. Turbine Inlet Silencer
46. Generator Blower (2)
47. Traction Motor Blower
48. Hand Brake
49. Turbine Control
50. Excitation Control
51. Propulsion Control
52. Fire Extinguishers
53. Control Air Reservoir
54. Protection Reservoir
55. Sand Boxes (4) — Total 40 cu. ft.
56. Dynamic Brake Resistor & Blower
57. Wheel Slip Control
58. Turbine Lube Oil Tank
59. Turbine Exhaust Casing
60. Turbine Fuel Processing Equipment
61. Exhaust Temperature Control Panel
62. Lube Oil Vapor Extractor
63. Turbine Fuel Forwarding Pump
64. Back Up Light
65. Air Brake Equipment
66. Fire Hose Plug-in Stations

Total Wheel Base of Locomotive 118'-2"
Total Length of Locomotive 132'-6"
Total Wheel Base of Locomotive and Tender 165' 3⅛"
Total Length of Locomotive and Tender 178' 11¼"

Union Pacific Railroad Company
Research and Mechanical Standards

Paul R. McDonald Collection

The last of the gas turbines, #30, is pictured at Laramie, Wyoming, on June 2, 1964, with a westward extra.

Union Pacific Turbine Roster

Road Numbers	Wheel Arrangement	Horsepower Rating	Drive Wheel Diameter	Gear Ratio	Weight on Drivers	Total Engine Weight	Starting Tractive Effort	Date Built	Builder	Notes
				Steam Turbine Electric						
1, 2	2-C-C-2	2,500	44"	65/31	346,000	548,000	86,500	1938	GE	1,2,3,4,8
				Gas Turbine Electric						
50	B-B-B-B	4,500	42"	74/18	534,000	534,000	126,500	1948	Alco-GE	5,6,8
51-56	B-B-B-B	4,500	40"	74/18	551,720	551,720	137,930	1952	GE	7,8,11
57-60	B-B-B-B	4,500	40"	74/18	551,720	551,720	137,930	1953	GE	7,8,9,11
61-75	B-B-B-B	4,500	40"	74/18	551,720	551,720	137,930	1954	GE	7,8,12
1-5	(C-C)+(C-C)	8,500	40"	74/18	849,248	849,248	212,312	1958	GE	7,8,10,13
6-11	(C-C)+(C-C)	8,500	40"	74/18	849,248	849,248	212,312	1959	GE	7,8,10,13
12-24	(C-C)+(C-C)	8,500	40"	74/18	849,248	849,248	212,312	1960	GE	7,8,10,13
25-30	(C-C)+(C-C)	8,500	40"	74/18	849,248	849,248	212,312	1961	GE	7,8,10,13
				Coal Burning Gas Turbine Electric						
80	A1A-A1A	2,000	40"	74/18	243,330	363,180	60,832	1961	Alco, UP	7,8,14,15,16,17
80B	2-D+D-2	5,000	40"	74/18	509,100	733,100	127,275	1962	GE, UP	7,8,18,19,20

NOTES:

1. Built on contract for Union Pacific but returned to General Electric who retained ownership.
2. Geared for passenger service with 125 miles per hour maximum speed.
3. Equipped for nose to back operation of the two units in multiple.
4. Renumbered GE-1 and GE-2 when owned by General Electric and used on the Great Northern Railway in 1943.
5. Owned by Alco-GE and tested by Union Pacific. Numbered GE #101 until June 1949.
6. Geared for dual-service with 79 miles per hour maximum speed.
7. Geared for freight service with 65 miles per hour maximum speed.
8. Equipped with dynamic electric brakes.
9. #57 converted to propane gas fuel from late May 1953 to January 4, 1954.
10. Two unit locomotive, permanently coupled. Second unit is lettered as the "B" unit.
11. Eventually multi-unit equipped on #55, 58, 59, 60.
12. Eventually multi-unit equipped.
13. Eventually multi-unit equipped on all but #1, 3, 5, 15, 24.
14. Multi-unit equipped for both leading and trailing units.
15. Ex-Alco PA-1 diesel #607 built January 1949 and rebuilt by UP Omaha Shops in June 1961.
16. Prime power unit is diesel engine.
17. Renumbered 8080 on April 1, 1964.
18. Ex-Great Northern Railway electric #5018 delivered June 1947, retired by G.N. in 1956, purchased by Union Pacific in 1959, and rebuilt by UP Omaha Shops in 1961-1962.
19. Prime power unit is coal/gas burning turbine engine.
20. Renumbered 8080B on April 1, 1964.

Union Pacific Turbine Roster

Road Number	Builders Serial Number	Builders Date	Date Shipped	First Date In Service	Retirement Date	Disposition
				Steam Turbine Electric		
1	12136	12-38	Note A	4- 5-39*	6-17-39*	Retired by GE after units returned from G.N. in 1943
2	12137	12-38	Note A	4- 5-39*	6-17-39*	Retired by GE after units returned from G.N. in 1943
				Gas Turbine Electric		
50**	30159	11-48	11-14-48	11-15-48**	4-1-51*	Retired by GE in late 1951
51	30760	1-52	1-24-52	1-31-52	4-30-62	#51-54: Trucks and other reusable parts were salvaged and shipped to the GE plant at Erie as trade-in on an order of U-25-B diesels.
52	30761	3-52	3-27-52	4- 9-52	4-30-62	
53	30762	4-52	4-25-52	5- 7-52	4-30-62	
54	30763	5-52	5-23-52	6- 4-52	5-31-62	
55	30764	6-52	6-27-52	7- 9-52	9-30-62	#55-75: Trucks, span bolsters, and other reusable parts were salvaged and shipped to the GE plant at Erie as trade-in on an order of U-50 diesels.
56	30765	8-52	8- 8-52	8-13-52	5-31-62	
57	30766	5-53	5- 5-53	5-20-53	12-31-62	
58	30767	6-53	6-17-53	7 -3-53	6-30-64	
59	30768	7-53	7-31-53	8-12-53	6-30-64	
60	30769	8-53	8-13-53	8-26-53	8-31-63	#51-75 The carbodies were eventually scrapped by Union Pacific in the mid-1960's. At least two were cut up at Cheyenne. Most, if not all, of the remaining carbodies were cut up at the Omaha shops.
61	32028	3-54	3-26-54	4- -54	8-31-63	
62	32029	4-54	4- 7-54	4-14-54	8-31-63	
63	32030	5-54	5- 5-54	5-19-54	10-31-63	
64	32031	4-54	4-27-54	5- 8-54	8-31-63	
65	32032	6-54	6- 1-54	6-11-54	8-31-63	Note: Union Pacific records indicate that the three ALCO C-855 freight diesels, numbers 60, 60-B, and 61, used span bolsters from the turbines.
66	32033	6-54	6-11-54	6-23-54	12-31-63	
67	32034	6-54	6-21-54	6-30-54	6-30-64	
68	32035	6-54	6-25-54	7-10-54	6-30-64	
69	32036	7-54	7-16-54	7-28-54	4-30-64	
70	32037	7-54	7-23-54	7-31-54	4-30-64	
71	32038	8-54	8-11-54	8-19-54	8-31-63	
72	32039	8-54	8-12-54	8-24-54	12-31-63	
73	32040	9-54	9-16-54	9-25-54	12-31-63	
74	32041	9-54	9-23-54	10- 2-54	4-30-64	
75	32042	10-54	10-21-54	10-31-54	10-31-63	

**Date indicated is applicable to Union Pacific service only.*

***Numbered GE 101 until 6-49. First date in revenue service on the UP was 7-30-49.*

Note A: Originally used in test service on the New York Central in 1-39. Arrived on the UP 4-4-39.

Union Pacific Turbine Roster

Road Number	Builders Serial Number	Builders Date	Date Shipped	First Date In Service	Retirement Date	Disposition
				Gas Turbine Electric		
1	33215	8-58	8-27-58	8-31-58	8-31-68	Sold to General Electric Erie Works 2-28-69.
1B	33210	"	"	"	"	" " " " " "
2	33207	9-58	9-19-58	9-26-58	8-31-68	Sold to General Electric Erie Works 3-11-69.
2B	33208	"	"	"	"	" " " " " "
3	33209	9-58	9-25-58	10- 2-58	8-31-68	Sold to General Electric Erie Works 3-24-69.
3B	33212	"	"	"	"	" " " " " "
4	33213	11-58	11-26-58	12- 3-58	8-31-68	Sold to General Electric Erie Works 4-7-69.
4B	33206	"	"	"	"	" " " " " "
5	33217	12-58	12-30-58	1- 8-59	1-31-69	Sold to General Electric Erie Works 5-8-69.
5B	33218	"	"	"	"	" " " " " "
6	33205	2-59	2-20-59	2-28-59	10-31-69	Sold to General Electric Erie Works 3-9-71.
6B	33216	"	"	"	"	" " " " " "
7	33211	2-59	3- 4-59	3-12-59	2-28-70	Sold to Continental Leasing 9-15-71.
7B	33214	"	"	"	"	" " " "
8	33219	3-59	3-27-59	4- 4-59	2-28-70	Sold to Continental Leasing 9-15-71.
8B	33220	"	"	"	"	" " " "
9	33221	11-59	11-20-59	12- 3-59	3-31-69	Sold to General Electric Erie Works 6-3-69.
9B	33222	"	"	"	"	" " " " " "
10	33223	12-59	12-11-59	12-19-59	2-28-69	Sold to General Electric Erie Works 1-7-71.
10B	33224	"	"	"	"	" " " " " "
11	33225	12-59	12-22-59	12-30-59	6-30-69	Sold to General Electric Erie Works 1-27-71.
11B	33226	"	"	"	"	" " " " " "
12	33227	2-60	2-10-60	2-18-60	10-31-69	Sold to General Electric Erie Works 1-7-71.
12B	33228	"	"	"	"	" " " " " "
13	33229	3-60	3- 9-60	3-19-60	10-31-69	Sold to General Electric Erie Works 11-28-69.
13B	33230	"	"	"	"	" " " " " "
14	33231	4-60	4- 1-60	4- 9-60	2-28-70	Sold to Nielsen Enterprises 8-71 who sold to Continental
14B	33232	"	"	"	"	Leasing. Note A.
15	33233	4-60	4-29-60	5- 7-60	1-31-69	Sold to General Electric Erie Works 6-20-69.
15B	33234	"	"	"	"	" " " " " "
16	34065	6-60	6-14-60	6-23-60	2-28-70	Sold to Nielsen Enterprises 8-71 who sold to Continental
16B	34066	"	"	"	"	Leasing. Note A.
17	34067	6-60	6-24-60	7- 7-60	3-31-69	Sold to General Electric Erie Works 1-26-71.
17B	34068	"	"	"	"	" " " " " "

Note A: The "A" cab units of turbines 14 and 16 were sold in 1975 to the G. F. Bean Co. of New Orleans and are presently (12-75) stored on Union Pacific property at Salt Lake City.

The "B" units of turbines 14 and 16 were consigned to Western Contracting, a subsidiary of Continental Leasing.

Road Number	Builders Serial Number	Builders Date	Date Shipped	First Date In Service	Retirement Date	Disposition
18	34069	8-60	8-10-60	8-19-60	2-28-70	Sold to Continental Leasing 9-15-71.
18B	34070	"	"	"	"	" " " "
19	34073	10-60	10- 4-60	10- -60	12-31-68	Sold to General Electric Erie Works 6-17-69.
19B	34074	"	"	"	"	" " " " " "
20	34071	9-60	9- 2-60	9-13-60	11-30-69	Sold to General Electric Erie Works 3-9-71.
20B	34072	"	"	"	"	" " " " " "
21	34075	10-60	10-21-60	10- -60	2-28-70	Sold to General Electric Erie Works 1-7-71.
21B	34076	"	"	"	"	" " " " " "
22	34077	11-60	11-25-60	12- -60	2-28-70	Sold to General Electric Erie Works 1-26-71.
22B	34078	"	"	"	"	" " " " " "
23	34079	12-60	12- 9-60	12- -60	2-28-70	Sold to General Electric Erie Works 3-9-71.
23B	34080	"	"	"	"	" " " " " "
24	34081	1-61	1- 4-61	1- -61	2-28-69	Sold to General Electric Erie Works 7-9-69.
24B	34082	"	"	"	"	" " " " " "
25	34083	1-61	1-27-61	2- -61	2-28-69	Sold to General Electric Erie Works 7-9-69.
25B	34084	"	"	"	"	" " " " " "
26	34085	2-61	2-17-61	2- -61	2-28-70	Sold to Continental Leasing 9-15-71.
26B	34086	"	"	"	"	" " " "
27	34087	3-61	3-17-61	3- -61	2-28-70	Sold to Nielsen Enterprises 8-71 who sold to Continental
27B	34088	"	"	"	"	Leasing. Scrapped at Houston Armature Works.
28	34089	4-61	4-14-61	4- -61	2-28-70	Sold to Continental Leasing 9-15-71.
28B	34090	"	"	"	"	" " " "
29	34091	5-61	5-12-61	5- -61	2-28-70	Sold to Continental Leasing 9-15-71.
29B	34092	"	"	"	"	" " " "
30	34093	6-61	6-27-61	7- -61	2-28-70	Sold to Nielsen Enterprises 8-71 who sold to Continental
30B	34094	"	"	"	"	Leasing. Scrapped at Learner-Pepper in Salt Lake City.

Note: Both units of locomotives 7, 8, 18, 26, 28, and 29 were stored (12-75) at Intercontinental Engineering Co., a subsidiary of Continental Leasing, at North Kansas City. Scrapping of these locomotives began in January 1976.

Coal Burning Gas Turbine Electric

80	76311	1-49/6-61	10-17-62	3-31-68	Traded to EMD 6-68 on diesel purchase.
80B	28448	5-47/10-62	"	"	Scrapped in Omaha during summer of 1968.

The retirement date listed is the last day the locomotive appeared on the Union Pacific roster. Retirement was normally approved during the month shown and removal from the roster would occur on the first day of the following month.

This roster was compiled from information received from the Union Pacific Railroad, Extra 2200 South, and Pacific News, in addition to material in the author's own files. It is believed to be accurate according to the information available, although some records located during research did contain a few conflicting dates. Any errors or omissions are the sole responsibility of the author in the presentation of the material.

The first four turbines, #51 to 54, were retired in the spring of 1962 and traded to GE on an order of 8 U-25-B diesels that were numbered 629-632 (high hood) and 637-640 (low hood). Units 627, 636, 637, 164 are shown at Topeka, Kansas, in the afternoon of October 10, 1966, enroute to Marysville with a 92 car westbound extra. Like the turbines, the 625 class U-25 diesels are now retired. No. 636 is ex-GE demonstrator 2504.

Thos. R. Lee

Thos. R. Lee

The remaining 4500 horsepower turbines were gradually traded to GE on an order of U-50 5000 horsepower diesels. #31, the first of the class, with #40 powers the symbol freight "AKO", Advance Kansas City-Omaha, at 30 miles per hour through Frankfort, Kansas, on June 18, 1965, with the 120 car westbound.

U-50's #32 and 46 roll a 97 car section of the westbound "KCM", Kansas City Manifest, east of Topeka, Kansas, at 40 miles per hour on September 28, 1968. The trucks and underframe on #32 came from turbine 65, one of the first "Verandas" to be retired.

Thos. R. Lee

R. H. Kindig

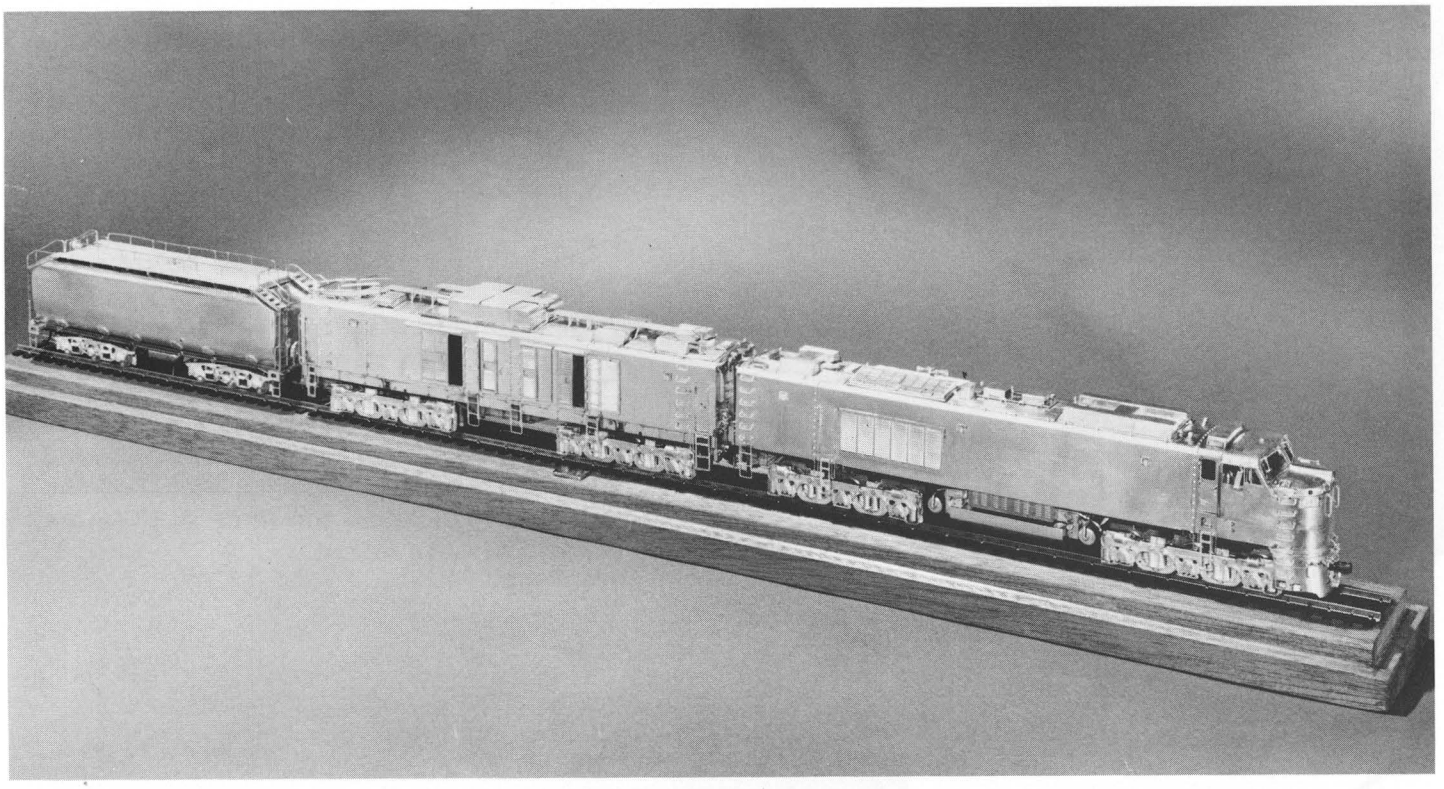
When Union Pacific entered the giant diesel market in the early 1960's, ALCO built three 5500 horsepower C-855 freight units on special order. Although not generally reported, records indicate that the span bolsters for these units came from the small turbines. In their characteristic style of heavy smoke, numbers 60 and 60-B are shown leaving Cheyenne, Wyoming, at 20 miles per hour with a 72 car westbound on September 15, 1966. Like the turbines, the three ALCO's are also retired.

The trucks used on the 5000 horsepower U-50-C GE diesels came from retired 8500 horsepower turbines. #5016 with DD-35B #97-B rolls down the hill west of Archer, Wyoming, on June 22, 1974, with a 91 car westbound extra at 50 miles per hour.

Thos. R. Lee

Thos. R. Lee

Both types of ex-turbine trucks are present on both classes of U-50 GE diesels in this photo as #154, the Salina-Kansas City freight, slows to enter the side track at Manhattan, Kansas, in the morning of May 12, 1973. The eastbound has 52 cars and is powered by #5013 and 48.



Chester J. Mack, Utah Pacific Co.

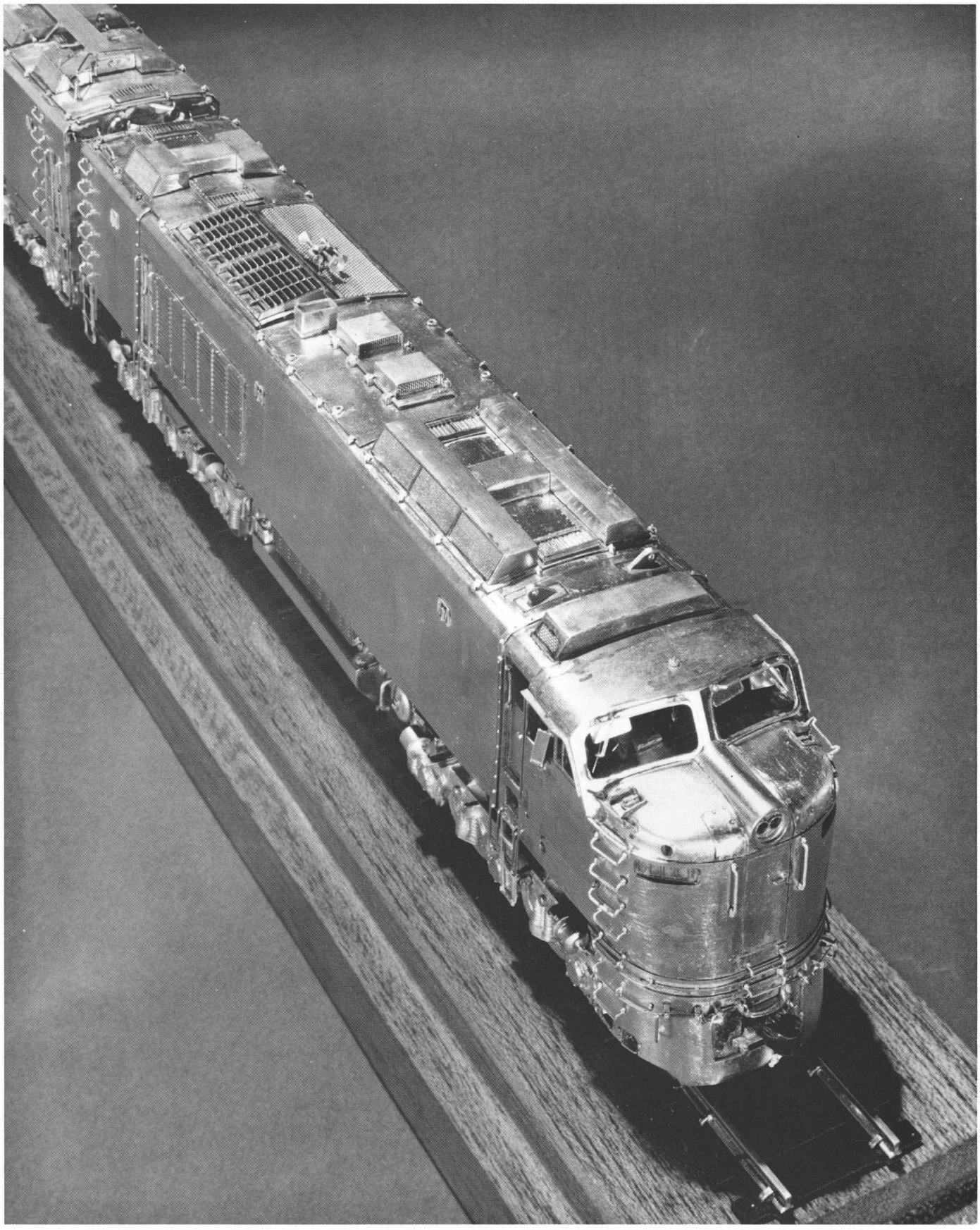
These two photos (above and opposite page) show an HO gauge, 1/87th scale model of a Union Pacific 8500 horsepower gas turbine electric locomotive. "It's the only one like it in the world," says Chester J. Mack, who is associated with the Utah Pacific Co. of Salt Lake City, Utah, manufacturer of model railroad products and owner of the unique miniature locomotive.

The all brass three unit model is based on prototype turbine #27 (pictured below) and contains extremely intricate detail. 414 lost wax investment castings were made especially for the accurately scaled model. All opening and sliding doors are working doors. Cab detail is complete, including the three seats for crew, engineer's controls, sun visors, working outside mirrors, and windshield wipers. All the numerous grab irons and ladders are also lost wax castings, a first in HO scale modeling.

The underbody and coupling detail is complete with wiring and cables, and the "B" unit contains interior turbine detail visible from the turbine exhaust opening. The most unusual feature of the model, however, becomes evident only during operation, as the "jet" like sound of the prototype gas turbine electric locomotive comes forth, truly enabling the viewer to relive the sound and operation of the turbine era on the Union Pacific Railroad.

Number 27 and GP-30 806 pull through Laramie, Wyoming, after a crew change on June 2, 1964, with another westward extra.

Paul R. McDonald Collection



Chester J. Mack, Utah Pacific Co.

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Research correspondence with R. E. Marquart, Richard E. Prince, Henry R. Griffiths, Richard H. Kindig, George Cockle, J. A. Rutherglen, Chester J. Mack, Wm. W. Kratville, and Dan Dover.

A. J. Wolff

Turbines 24 and 10 await westbound calls at Laramie on September 29, 1968. The sun had yet to set on the turbine era.

Emil Albrecht

X-25 West rolls downgrade through Echo Canyon on September 2, 1961.

INDEX OF TURBINE PHOTOGRAPHS

(ORIGINAL EDITION)


UNION
PACIFIC
RAILROAD

TURBINES WESTWARD

Second Edition Supplement

After TURBINES WESTWARD went to press in its original format, many additional photographs of interest plus information of historical nature became available from several sources. This supplement contains the material which the author feels should be included in a reference volume on the Union Pacific's turbine locomotives.

Several people supplied excellent photographs or other information for this supplement and to Gordon Glattenberg, T. M. Hotchkiss, Rev. Harold Keekley, R. H. Kindig, Richard L. Schmeling, Art Stensvad, Leon Callaway, Newman MacDonald of General Electric, R. E. Prince and Greg B. Davies of the Union Pacific my sincere thanks for their contributions. Mr. Davies has recently published several fine books on Union Pacific's passenger and freight equipment. I appreciate his sharing the turbine material he salvaged from files which were destined for a finality similar to the locomotives themselves.

Hopefully you will find this supplement a worthy addition to the original book.

September 1977 *Thos. R. Lee*

Union Pacific Railroad

This snappy photo was another of the publicity shots the U.P. photographers took when #50 first arrived at Omaha on July 28, 1949. The gas turbine made a test run the next day as a helper engine westbound from Omaha.

Record of gas-turbine locomotive #50 delivery to the Union Pacific. (UPRR MAILGRAM)

Omaha - July 20, 1949

To: Mr. D. S. Neuhart

We will about July 29 receive at Omaha a 4500 h.p. gas turbine electric locomotive, manufactured by General Electric Company, for test operation in actual service.

The locomotive will be delivered to us at Erie, Pennsylvania, about July 25 and will be moved on commercial billing to Omaha. It is expected the test of the unit will start August 1, and, after a tour of the railroad, will be put in operation between Salt Lake City and Los Angeles, and possibly on the Wyoming Division in regular service.

The locomotive is furnished us on a loan basis, and agreement covering the test of the equipment is now in the course of preparation, but comtemplate the unit will be operated in freight service only, and the railroad will provide all labor, services, parts, materials and supplies which may be required to operate and maintain the locomotive in proper condition and repair, except special parts, tools and material that will be furnished by General Electric Co.

Fuel oils, lubricating oils, greases and other materials necessary for proper operation of the locomotive are to be supplied by Union Pacific and to be specified and approved by General Electric. The main fuel oil shall be in accordance with U.S. Navy Specification 7-0-1f and supplement thereto 7-0-lg.

During the time the locomotive is operated on the Union Pacific Railroad, it will be manned and operated only by Union Pacific employees. No other person except employees of General Electric designated by it for instruction and supervision purposes shall be permitted to inspect or ride the locomotive in any capacity, except upon prior written approval of General Electric.

It is desired that a complete record be made of the performance of this locomotive, and it will be necessary that all charges and costs in connection with its operation be segregated so that its actual performance can be determined.

With the view of maintaining proper reports, I will appreciate you making such arrangements as are necessary to accumulate information sufficient to render a report, similar to the D-187, monthly, giving the performance of this locomotive. It perhaps would be desirable to issue an appropriate shop order and have all charges and costs in connection with the test accumulated against the shop order.

As promptly as consistent after the close of each month, you should furnish me six copies of report showing the performance of the locomotive during the prior month.

/s/ P. J. Lynch

Omaha - July 25, 1949

To: Mr. H. E. Shumway

Referring to agreement with General Electric Company covering test of 4500 h.p. gas turbine electric freight locomotive, as covered by agreement sent you with Mr. Bennewitz's letter July 21, 1949, file C-34854:

It is important that the initial use of this locomotive on the Union Pacific be in revenue service leaving Omaha, and you will please see that there are revenue freight cars with commercial lading in the train making the initial test leaving from Omaha.

/s/ P.J. Lynch

50 The experimental gas turbine electric locomotive arrived at Omaha on July 28, 1949. Its first service occurred the next day when #50 was used as a helper engine ahead of a 9000 class 4-12-2 steamer westbound out of Omaha. The unique engine was put on public display at Omaha Union Station on Saturday, July 30 between 9:00 a.m. and 10:00 a.m. before leaving on its initial revenue test run at noon.

In compliance with the order from Mr. Lynch, the consist included ten revenue freight loads ahead of 59 empty refrigerator cars. The six passenger cars behind #50 included U.P. baggage car 1797 (used for hauling supplies and additional crankcase and lubricating oil), and chair car 2783. The four official business cars, #124, 121, 123, and 100, preceded the freight consist. The 124 was assigned to David S. Neuhart, Superintendent of Motive Power; the 121 to H. E. Shumway, General Manager; the 123 to P. J. Lynch, Vice President of Operations; and the 100 was President Arthur E. Stoddard's car.

On August 1st #50 was used in helper service between Cheyenne, Wyoming, and Sherman station (altitude 8,013 feet) at the summit of Sherman Hill. U.P. officials said the engine "exceeded all expectations at that altitude." Tuesday, August 2nd found the gas turbine working to Denver, before leaving for Pocatello on the 3rd. The working barnstorming tour would see the locomotive put on public display at Portland, Seattle, and Tacoma before leaving the Northwest District in mid-August for Los Angeles. The first day of regular freight service operation from Los Angeles was August 22, 1949. Diesel fuel oil was used on the tour as Bunker "C" fuel was not available system wide with the required specifications.

The test locomotive was operated on straight Bunker "C" fuel, in which vanadium pentoxide and sodium sulphate in the fuel ash reacted with the alloy steels to produce surface and depth corrosion, respectively.

By 1952, when the first production locomotives were put in service, General Electric in cooperation with the oil industry and especially the Richfield Oil Corpora-

tion had evolved a specification establishing controls as follows:

1. The ratio of sodium to vanadium in the ash was not to exceed 0.3.
2. The ratio of calcium to vanadium in the ash was to be not less than 5.0.
3. Magnesium, barium and nickel in the ash were a benefit and could be substituted for calcium at 2 atoms per one atom of calcium.
4. The total ash in the compounded residual fuel oil should not exceed 0.2%.

It was realized that this fuel would form deposits on the first stage nozzles and first stage rotor buckets, but this was considered less harmful than the corrosion.

UPRR MAILGRAM Records of last movements of gas-turbine locomotive #50 on the Union Pacific.

Omaha - April 18, 1951

To: Mr. H. E. Shumway
Mr. D. S. Neuhart

For your information, Manager Wilson of the General Electric Company, Omaha, advised me under date of April 17th that gas-turbine locomotive X-50 should be delivered to the Southern Pacific at Ogden, who will accept in on May 1st.

Meanwhile, after locomotive has been thoroughly tested out, you may move it to Ogden and hold it at that point for delivery.

/s/ P. J. Lynch

J. A. Rutherglen Collection

Number 50 is on the last leg of its working tour to the northwest as it travels through the Blue Mountains of eastern Oregon. Part of the passenger car consist was changed during different segments of the tour.

MONTHLY REPORT SUMMARY

GAS TURBINE ELECTRIC LOCOMOTIVE U.P. #50

Month-Year	Remarks	Locomotive Miles	Gross Ton Miles (In Thousands)	Diesel Fuel Oil (Gallons)	Bunker "C" (Gallons)
July 1949		596	1,426	10,702	--
Aug. 1949		6,530	15,183	43,084	46,568
Sept. 1949		5,348	14,752	4,363	89,161
Oct. 1949	Note 1	6,717	17,694	51,256	82,378
Nov. 1949		3,126	8,275	1,925	60,959
Dec. 1949	Not Operated	--	--	--	--
Jan. 1950	Not Operated	--	--	--	--
Feb. 1950		1,485	3,103	3,868	25,704
March 1950		7,906	22,424	6,435	132,412
April 1950		8,371	33,993	6,375	137,733
May 1950		4,664	17,563	2,725	44,600
June 1950	Not Operated	--	--	--	--
July 1950		6,824	25,526	2,650	72,434
Aug. 1950		7,937	33,280	2,490	78,665
Sept. 1950		6,114	20,442	79,780	9,500
Oct. 1950	Note 2	11,269	46,218	179,190	--
Nov. 1950	Note 3	8,548	32,050	123,250	--
Dec. 1950	Not Operated	--	--	--	--
Jan. 1951	Note 4	62	--	--	--
Feb. 1951		5,457	21,632	4,433	54,890
March 1951		10,091	36,046	6,440	141,114
April 1951	Note 5	186	--	--	--
Totals on U.P.		**101,231**	**349,607**	**528,966**	**976,118**
				- 1,505,084 -	
Lifetime Totals	**Note 6**	**105,732**	**363,816**	**- 1,797,426 -**	

Remarks:

Note 1: The increased diesel oil consumption in October 1949 was due to exclusive use of diesel fuel oil for two round trips Los Angeles - Las Vegas and one round trip Los Angeles - Salt Lake City, to develop comparative effect of diesel and Bunker "C" fuel oil on nozzles and combustion chambers of the locomotive.

Note 2: Locomotive was used extensively in tests over Eastern District, operating only on diesel fuel oil. Total diesel fuel used in turbine only was 173,205 gallons, plus 5,985 gallons used for starting main engine and operating auxiliary diesel engine. Equivalent for Bunker "C" operating main turbine would be 153,806 gallons which represents .888 conversion factor diesel fuel to Bunker "C". (Data from U.P. files/D.S. Neuhart)

Note 3: Locomotive was in the Cheyenne shops from November 15, 1950, to January 30, 1951, undergoing alterations and modifications for test purposes, which were made on request of GE representatives. Cost of changes was $23,433.41, with entire expense being assumed by the General Electric Company. (Data from U.P. files/R. M. Sutton)

Note 4: Locomotive made one helper round trip, Cheyenne to Sherman station on January 31, 1951. Expenditures and fuel oil consumption figures are included in the February 1951 monthly report.

Note 5: Locomotive was operated on three helper round trips, Cheyenne to Sherman station on April 1, 1951, and then removed from service on the U.P. Expenditures and fuel oil consumption figures were included in the March 1951 monthly report.

Note 6: Total lifetime figures are from June 4, 1951, issue of *Railway Age* as reported by General Electric. The locomotive mileage of 105,732 includes service on the Pennsylvania Railroad and the Nickel Plate Road, but no mention is made of tests on the Southern Pacific in May 1951. The total fuel oil consumption of 1,797,426 gallons includes some power plant testing on the water box where no locomotive mileage was produced. *Railway Age* reported that operation of #50 on the Union Pacific was terminated on March 31, 1951, however, that is incorrect.

Omaha - April 23, 1951

To: Mr. P. J. Lynch

Gas-turbine locomotive X-50 will be moved dead in train, leaving Cheyene this date, to Ogden for delivery to the Southern Pacific.

/s/ H. E. Shumway

Omaha - April 27, 1951

To: Mr. P. J. Lynch

Re: Gas-turbine locomotive X-50.

This locomotive was moved Chian to Ogden dead in train, arriving Ogden 2 PM April 24th and was placed in roundhouse. There were no exceptions on the trip enroute. GE and SP representatives requested locomotive transferred to SP at Ogden, and it was delivered to them at 9:30 AM 26th so that it could be equipped with ATC as used on SP and tested out for use on that line.

/s/ D. S. Neuhart

Omaha - June 21, 1951

To: Mr. H. E. Shumway

General Electric's gas turbine test locomotive, now en route from Grand Island, should, I understand, reach Council Bluffs around 2:00 PM or 2:30 PM today. Arrange to move this locomotive on commercial billing to General Electric Company, Erie, Pennsylvania, routing "C&NW, IHB, NYC", the freight charges for movement Council Bluffs to Erie to be assumed by UPRRCO.

/s/ P. J. Lynch

51-60

On December 13, 1950, a work order was authorized for the purchase of ten 4500 h.p. gas turbine electric locomotives and one spare turbine compressor unit at a total estimated cost of $5,400,000. The Korean War had started six months earlier, and the work order notes "the necessity to handle the prospective volume of traffic anticipated as a result of the international situation."

ORDER NO. 5922-6, dated March 19, 1951, was submitted to the General Electric Co. office at Omaha by G. T. Wickstrom, UPRR General Purchasing Agent. The general terms of the order were as follows:

EQUIPMENT: Ten (10) Gas Turbine Electric Road Locomotives.
One (1) Spare turbine-compressor unit for main locomotive power plant.

PRICE: $502,035 for each locomotive, plus freight charges f.o.b. Erie, Pa. $190,000 for the spare turbine-compressor plus freight charges f.o.b. Erie, Pennsylvania.

WARRANTY: General Electric guarantees the locomotives to be free of defects and will repair or replace any part which requires repair either within one year after delivery or prior to completion of the first 100,000 miles of normal use and service, whichever shall first occur.

SPECIAL WARRANTIES:

(a.) The gas turbine rotor and the second stage nozles are each warranted for 15,000 hours of turbine operation.

(b.) The first stage nozzle is warranted for 8,000 hours of turbine operation.

(c.) The combustion chambers will be warranted up to 1,000 hours of operation provided the unit is supplied with fuel according to GE specifications. General Electric reserves the right to change specifications for fuel and additives as experience may indicate. The railroad company reserves the right to operate locomotives on a fuel other than that specified if it is not possible to obtain specified fuel and/or an additive.

UPRR MAILGRAM messages concerning locomotives #51-60.

Omaha - June 11, 1952

To: Mr. D. S. Neuhart

Purchase order No. 20-NT-10541-Y dated June 6 covers purchase of material to convert one Gas Turbine Electric Locomotive to burn Propane, an estimated cost of $7,595.00. Our files do not indicate that work order authority has been provided for this change, although the purchase order does give reference to the work order 9139.

Please advise promptly if this equipment is considered experimental and chargeable to operating expenses or if it is permanent equipment that should be capitalized.

/s/ E. R. Miller

Omaha - June 16, 1952

To: Mr. E. R. Miller

Experimental development for modification of gas turbine locomotive No. 51 to burn propane fuel is being undertaken in conjunction with General Electric and Richfield Oil Companies. The work is entirely of an experimental nature and chargeable to Operating Expenses.

/s/ D. S. Neuhart

(Note: This experimental project for turbine No. 51 was later cancelled, date unknown.)

New gas turbine #54 is being serviced at North Platte, Nebraska, on June 5, 1952, before continuing westward on its initial trip.

Both photos by Art Stensvad

Locomotive #55 waits in the North Platte yard on July 9, 1952, on the first trip in service for the new turbine.

SUMMARY OF DELIVERY AND INITIAL SERVICE RECORDS FOR LOCOMOTIVES # 51-60

Locomotive Number	Received at Omaha Shops Date	Time	Initial Service Trip from Omaha Date	Time
51	Jan. 28, 1952	12:45 a.m.	Jan. 31, 1952	6:45 p.m.
52	April 4, 1952	12:30 p.m.	April 9, 1952	12:40 p.m.
53	Information Unknown		May 7, 1952	---
54	May 31, 1952	9:20 a.m.	June 4, 1952	10:18 p.m.
55	July 8, 1952	7:30 a.m.	July 9, 1952	2:00 a.m.
56	Aug. 11, 1952	10:50 p.m.	Aug. 13, 1952	5:57 a.m.
57	May 20, 1953	3:40 a.m.	May 21, 1953	3:45 p.m.
58	June 27, 1953	9:45 a.m.	July 3, 1953	4:30 p.m.
59	Aug. 8, 1953	9:15 a.m.	Aug. 12, 1953	4:11 p.m.
60	Aug. 22, 1953	5:45 a.m.	Aug. 26, 1953	12:05 p.m.

Omaha - May 21, 1953

To: Mr. A. E. Stoddard

Seventh gas turbine electric locomotive No. 57 was received at Omaha Shops 3:40 AM May 20 and departed westbound 3:45 PM May 21.

/s/ D. S. Neuhart

Note: This locomotive had been selected for tests using propane as fuel. Number 57 was released by General Elecrtric on May 5, 1953, and was on public display May 14, 1953, at Chicago, Illinois, for a U.P. press conference.

Omaha - June 12, 1953

To: Mr. R. M. Sutton

In connection with tests being conducted on gas turbine locomotive 57 using propane as fuel, shall appreciate if you will arrange to report this turbine separately on Form 532 and other Accounting Department records showing performance, costs, etc.

/s/ D. S. Neuhart

Omaha - July 2, 1953

To: R. M. Sutton

Supplementing my previous letter concerning operation of gas turbine electric locomotive No. 57.

In order that the statistics for this locomotive will afford a reasonable basis for comparison with other gas turbine electric locomotives, suggest that the data reflect operation commencing with June 18, which was the first trip after release of locomotive following initial preparations for test operation now in progress.

/s/ D. S. Neuhart

Note: After initial revenue run of May 31, 1953, was made between Los Angeles and Las Vegas, additional test modifications were made until June 18, 1953.

Locomotive #57 used propane fuel in revenue service May 31, 1953, to January 4, 1954. Locomotive miles burning propane before conversion back to Bunker "C" was 69,600 with 2,961 turbine hours.

Omaha - June 30, 1953

To: Mr. H. E. Shumway

Gas turbine electric locomotive 58 now Omaha Shop will be available for 7 AM call July 1 to run light on break-in trip Omaha to Fremont and return.

It is desired to take pictures of this locomotive at Fremont and after this is accomplished locomotive should be returned to Omaha Shop preparatory to dispatching westbound handling freight train to Green River for assignment out that point.

/s/ D. S. Neuhart

61-75 On December 15, 1952, a formal order was given to General Electric for the purchase of fifteen 4500 h.p. gas turbine electric locomotives and one spare turbine compressor unit at a total estimated cost of $8,600,000.

ORDER NO. 5950-6 was submitted to the General Electric Co. office at Omaha by G. T. Wickstrom, UPRR General Purchasing Agent. The general terms of the order were as follows:

EQUIPMENT: Fifteen (15) Gas Turbine Electric Road Freight Locomotives. One (1) Spare turbine-compressor unit for main locomotive power plant.

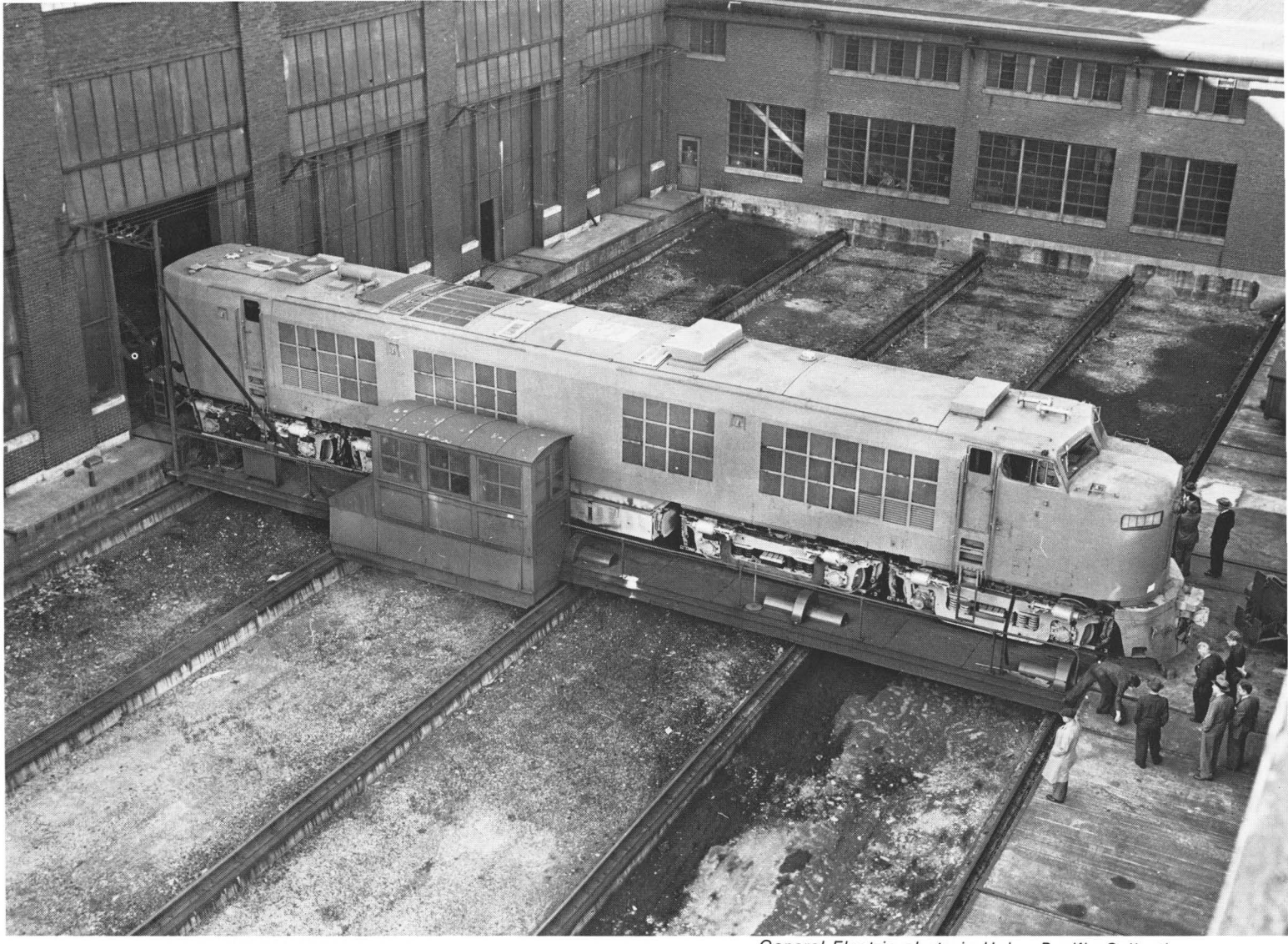
PRICE: $531,415.50 for each locomotive,plus freight charges f.o.b. Erie, Pa. $200,450.00 for the spare turbine-compressor unit plus freight charges f.o.b. Erie, Pennsylvania.

It is mutually agreed that if prior to shipment of this order general change in the cost of manufacturing occurs by reason of increase or decrease in prices of materials or locomotive builder's labor costs, to the extent such price changes apply to construction of equipment covered by this order they shall be added to or deducted from prices hereinbefore set forth. Any increase in prices shall not exceed ten percent (10%).

WARRANTY: General Electric guarantees the locomotives to be free of defects and will repair or replace any part which requires repair either within one year after delivery or prior to completion of the first 100,000 miles of normal use and service, whichever shall first occur.

SPECIAL WARRANTIES: Same as listed for locomotives 51-60.

(d.) The spare turbine-compressor unit will carry the same warranty against defective workmanship and material as the locomotives, except that the period of warranty will be one year from date of shipment or six months from date of application thereof to a locomotive, or 100,000 miles of service on locomotives to which applied, whichever shall first expire. Special warranties as outlined earlier above shall also apply to this unit.



General Electric photo in Union Pacific Collection

New gas turbine #55 rides the transfer table at the General Electric plant at Erie, Pennsylvania, in June 1952.

Art Stensvad photo, R. L. Schmeling Collection

Gas turbine #66 at North Platte, Nebraska, March 3, 1956.

Gas turbine 70 teams with a set of EMD F units at Ogden, Utah, in May 1958.

John W. Lawson photo, R. L. Schmeling Collection

It was a windy, cold -8° on Sherman Hill November 2, 1955, when Rev. Harold Keekley caught turbine 56 switching some cattle cars at Hermosa, Wyoming, on an eastbound extra.

Harold Keekley

Of the 4500 horsepower gas turbines, #58 had the longest service record. Assisted by two GP-9's, the 58 heads toward Evanston, Wyoming, with an eastbound extra of 118 cars in the late afternoon of June 13, 1960.

SUMMARY OF DELIVERY AND INITIAL SERVICE RECORDS FOR LOCOMOTIVES # 61-75

Locomotive Number	Received at Omaha Shops Date	Time	Initial Service Trip from Omaha Date	Time
61	Information unknown		Information unknown	
62	April 10, 1954	9:30 p.m.	April 14, 1954	11:25 a.m.
63	May 16, 1954	6:20 a.m.	May 19, 1954	11:40 a.m.
64	May 6, 1954	12:45 a.m.	May 8, 1954	9:50 a.m.
65	June 9, 1954	12:45 a.m.	June 11, 1954	1:30 p.m.
66	June 19, 1954	11:00 a.m.	June 23, 1954	12:10 p.m.
67	June 27, 1954	11:10 p.m.	June 30, 1954	12:25 p.m.
68	July 8, 1954	9:25 p.m.	July 10, 1954	12:10 p.m.
69	July 24, 1954	9:17 a.m.	July 28, 1954	12:11 p.m.
70	July 29, 1954	1:10 p.m.	July 31, 1954	11:41 a.m.
71	Aug. 18, 1954	12:43 a.m.	Aug. 19, 1954	4:30 p.m.
72	Aug. 21, 1954	3:15 a.m.	Aug. 24, 1954	4:45 p.m.
73	Sept. 24, 1954	6:50 a.m.	Sept. 25, 1954	10:25 a.m.
74	Sept. 30, 1954	11:15 p.m.	Oct. 2, 1954	12:01 p.m.
75	Oct. 28, 1954	6:45 a.m.	Oct. 31, 1954	12:16 p.m.

Art Stensvad photo, R. L. Schmeling Collection

Paul McDonald Collection

X-73 East races across the Nebraska flatlands toward North Platte with a fruit train in a photo taken in the late 1950's. (Left) Brand new turbine 61 is being hauled through Elyria, Ohio, on the New York Central enroute to Council Bluffs. March 27, 1954. (Below) The first of the "verandas" was captured on film the following month during a trip across Wyoming.

Art Stensvad

On page 56 mention was made of the General Electric service engineers who worked with the Union Pacific turbine staff. I regret that the name of Clarence Kerr was omitted in the original edition for Mr. Kerr was head of the GE turbine staff in the field during the early 1950's.

Art Stensvad photo, R. L. Schmeling Collection

X-75 West roars across a bridge at the west edge of Laramie, with a typical Wyoming sky providing the background.

1-30 A formal order, dated November 25, 1955, was given to General Electric for the purchase of fifteen 8500 h.p. gas turbine electric locomotives and one spare turbine-compressor and gear assembly unit, plus a commitment for an additional thirty such locomotives to be ordered later. The total estimated cost for all 45 locomotives was $38,000,000.

ORDER NO. 5980-6 was submitted to the General Electric Co. office at Omaha by G. T. Wickstrom, UPRR General Purchasing Agent. The general terms of the order were as follows:

EQUIPMENT: Fifteen (15) Gas Turbine Electric Road Freight Locomotives, Model GTEL 8500-HP.
One (1) Spare turbine-compressor and gear assembly unit, complete, for main locomotive power plant (mounted on skid).

The GE proposal also reads, in part -

"We will require a firm order for fifteen (15) locomotives, and a commitment for the additional thirty (30). This commitment is to be converted into an order for fifteen (15) by November 1, 1956, and an order for the remaining fifteen (15) by June 1, 1957.

"If a total of less than 45 locomotives are finally ordered, the unit price, adjusted for escalation as necessary, shall apply, plus reasonable and proper charges for cancellation of the orders and commitments, including, but not limited to, unliquidated engineering and shop modification expense.

"We agree to relieve the Union Pacific Railroad Company of the above cancellation charges to the extent other railroads purchase duplicate GTEL-8500 locomotives during the term of this contract."

PRICE: $850,000 for each locomotive, plus freight charges f.o.b. Erie, Pa. $381,500 for the one spare turbine-compressor and gear assembly unit complete, with skid, plus freight charges f.o.b. Schenectady, New York.

It is mutually agreed that if prior to shipment of this order general change in the cost of manufacturing occurs by reason of increase or decrease in prices of materials or locomotive builder's labor costs, to the extent such price changes apply to construction of equipment covered by this order they shall be added to or deducted from prices hereinbefore set forth. Any increase in prices shall not exceed ten percent (10%).

This price adjustment clause shall apply to each locomotive order placed. The initial unit price for each such locomotive order shall be the escalated price in effect.

WARRANTY: General Electric guarantees the locomotives to be free of defects and will repair or replace any part which requires repair either within one year after delivery or prior to completion of the first 100,000 miles of normal use and service, whichever shall first occur.

SPECIAL WARRANTIES:

(a.) The gas turbine rotor and the second stage nozzles are each warranted for 15,000 hours of turbine operation.

(b.) The first stage nozzle is warranted for 8,000 hours of turbine operation.

(c.) The combustion chambers will be warranted up to 1,000 hours of operation provided the unit is supplied with fuel according to GE specifications. General Electric reserves the right to change specifications for fuel and additives as experience may indicate. The railroad company reserves the right to operate locomotives on a fuel other than that specified if it is not possible to obtain specified fuel and/or an additive.

(d.) The spare turbine-compressor will carry the same warranty against defective workmanship and material as the locomotives, except that the period of warranty will be one

year from the date of application thereof to a locomotive, or 100,000 miles of service on locomotives to which applied, whichever shall first occur.

On February 19, 1957, formal announcement was made by U.P. President, Arthur E. Stoddard, that a second group of fifteen 8500 horsepower gas turbine electric locomotives had been ordered from General Electric. Total cost of the second 15 locomotives was to be approximately $15,000,000, with delivery expected to begin early in 1958.

OPERATION OF 8500-Hp GAS TURBINES IN LOCOMOTIVE SERVICE

(Excerpts from a report dated October 1960 Harold Rees, Chief Mechanical Officer, Union Pacific Railroad, Omaha.)

On August 31, 1958, the first of an order of 30 gas-turbine-electric locomotives was placed in service on the Union Pacific Railroad. It is powered by a single gas turbine rated 8500 hp at 6000 ft. elevation and 90° F ambient. The power plant is a new model General Electric frame size 5, simple-cycle, single-shaft, two-bearing machine having a 16-stage axial compressor and 2-stage turbine.

Four locomotives were delivered in 1958 and seven in 1959. This slow rate of delivery permitted the manufacturer to incorporate in later turbines the improvements which resulted from observations and problems of the turbine in service. By October 1, 1960, nineteen locomotives were in main-line freight service between Council Bluffs, Iowa, and Ogden, Utah.

Service conditions for these gas turbines are severe. In stationary service a gas turbine generally operates with few starts and stops, under a comparatively steady load. Locomotive service imposes frequent starts and stops, with a load that varies. Because of railroad-clearance requirements there is practically no space available for the filtering and silencing of inlet air. The close confines of the locomotive car body make inspection and maintenance difficult. The turbine must withstand the vibration and shock loads of railroad operation.

These rugged conditions are ideal for the accelerated testing of equipment. It is almost axiomatic that equipment which has given excellent trouble-free service in air, marine and stationary installations will develop unheard of troubles and shortcomings when operated in a railroad vehicle. The 4870-hp four-bearing gas turbines placed in locomotive service 1952-54 developed problems in the first 10,000 hours which did not show up in identical units in stationary service until years later — if at all.

By October 1, 1960, the 19 turbines in service had amassed a total of 95,727 fired hours. As shown in the following table, the maximum fired hours for any one turbine was 10,218, the minimum 306.

There have been 22 occasions to open up a turbine prime mover partially or completely. Three turbines were opened due to failed inlet silencer parts entering the compressor and damaging compressor blading. Ten turbines were opened for scheduled inspection and modifications. Nine turbines had unscheduled openings because of trouble originating in the turbine requiring immediate repair.

An idea of the work potential of these locomotives can be gained from the mileage performance during the year 1959. Since locomotives numbers 5 through 11 were delivered progressively through 1959, the total service for the group that year was 90 locomotive months, or an average of slightly less than eight locomotives. Performance figures for 1959 are:

Total locomotive miles	1,076,772
Average miles per locomotive per month	11,911
Total freight train miles	1,035,729
Total freight gross ton-miles	4,314,769,000
Percentage of Union Pacific Systems total freight gross ton-miles hauled	5.3%

During the month of September 1960, with 19 locomotives in service, the average miles per locomotive was 11,776; 12.6 per cent of the U.P. System's total freight gross ton-miles was hauled. During this same month, 75 new SD-24 and 30 new GP-20 diesel-electric units assigned in comparable service on the same district averaged 12,110 and 12,322 miles per locomotive unit, respectively.

This turbine (prime mover), when ordered, was an entirely new model. Many modifications were developed on the manufacturer's test stand before the first locomotive was delivered in 1958. The need for others was discovered in field service. Improvements developed as the result of service problems were immediately incorporated by the manufacturer in turbines yet to be delivered.

Prior to the delivery of the first locomotive, factory tests had revealed that a serious rotor bow condition could develop during short shutdown periods. This was not compatible with the start-and-stop type of operation to which these locomotives would be subjected. To prevent this condition the gas turbine is automatically placed on cool-down crank at 750 rpm whenever it is shutdown. Cranking is performed by motoring the No. 1 generator. If this cranking should fail, the rotor would bow and cause excessive vibration when the turbine was restarted. In the event that the auxiliary diesel engine could not supply power to motor the No. 1 generator, the cool-down cranking feature would be lost.

To prevent excessive rotor bow under such abnormal circumstances the manufacturer developed an air-circulation system for the distance piece. This distance piece is located at about the mid-point of the compressor and turbine-rotor assembly. A small battery-powered, motor-driven blower provides sufficient air to keep the hot air around the distance piece from stratifying and maintains rotor bow below vibration limits. This feature proved its worth on the very first trip of locomotive no. 1 when a faulty field-coil connection in the No. 1 generator was discovered at an intermediate station.

AUTHOR'S NOTE: General Electric field service engineer Newman MacDonald rode locomotive No. 1 on the first trip from Omaha on August 31, 1958. His log book records indicate that he repaired a loose connection in the cranking circuit of the No. 1 main generator at Cheyenne on September 1, 1958. He further notes that there were numerous flameouts on the initial trip, Omaha to Ogden, because the Bunker "C" fuel oil was too hot, at a temperature in excess of 240 degrees.

After starting on diesel fuel, automatic transfer was made to a specification type residual fuel having a viscosity of approximately 95 SUS at 210 degrees Fahrenheit. Specifications provided that the weight ratio of sodium to vanadium be kept below 0.3, and the weight ratio of magnesium to vanadium be kept above 3.0.

On April 19, 1959, the air-inlet silencers on three locomotives (including #2) collapsed due to an unusual weather condition which prevailed in the North Platte, Nebraska, area. Weather conditions were favorable to icing of the screened opening of the inlet silencer. Ice formed gradually and eventually closed the opening in the screen. The resulting negative pressure inside the silencer caused it to collapse. Compressors were not opened since visual inspection indicated that very little damage had occurred to the blades.

To prevent a recurrence of this type of failure, GE designed a shutter arrangement in the floor of the silencer which opened whenever the interior pressure decreases slightly and admits warm air from the car body. These were manufactured in the U.P. shops and installed on all turbines.

A few of the other turbine modifications made during the first two years of operation are as follows:

Fuel screens on fuel nozzles plugged so often it was decided to remove them. No detrimental effect on fuel-nozzle performance occurred as a result of this removal.

There were several cases of compressor pulsation. On one occasion, 8 hours were spent trying to start a turbine. Each time the turbine was fired it would "hang up" at 2,800 to 3,100 rpm and have to be shut down. It was eventually started by removing the orifices in the 10th stage extraction lines that supply air for turbine-shell cooling. This change was made on all turbines. The pulsation margin was improved on later machines by increasing the size of the first-stage nozzle opening 10 per cent and slightly modifying the combustion chamber liner. This change began with turbine 97671, locomotive 10.

The tendency of early turbines to flame out was largely corrected by the addition of an altitude compensator to the governor and changes to airhole and louver arrangement in the liners.

The turbine accessories such as fuel pump, hydraulic pump, fuel-flow divider, exhaust-control system, governor, lube-oil pumps, atomizing air compressor, and vapor-extraction blower in general performed quite well. Some items were the cause of aggravating road failures and delays. Some of the more interesting ones were as follows:

The shaft seal on the fuel pump was a constant source of trouble in the first year. The hot residual fuel formed a deposit on the seal spring which gradually made the seal ineffective. Improved seals applied during 1960 gave a remarkedly better service life of 9 months.

The fuel by-pass valve, which was a part of the hydraulic pump that drives the fuel-flow divider, also gave considerable trouble due to sticking and short seal life. New design seals and valve stems were developed and installed in late 1960.

The exhaust control system required excessive maintenance and frequent failures occurred.

Several failures of atomizing air compressors caused severe damage to combustion-chamber liners, caps and transition pieces due to lack of atomizing air. A differential pressure switch was installed to sound an alarm when atomizing air pressure was too low.

The various combustion-chamber components required maintenance at different usage intervals. Liners and caps were repaired at approximately 1,600 hour intervals, and transition pieces at 5,000 to 7,000 hour intervals.

At the time this supplement was written, several of the 8,500 horsepower gas turbine locomotives, or units thereof, still remained. The cab units of locomotives 14 and 16 still remained on U.P. property at Salt Lake City for owner G. F. Bean Co.; while turbines 18, 26, 28 and 29 were still stored at Intercontinental Engineering Co. in North Kansas City, Missouri.

Number 18 was donated to the Kansas City Railroad Museum on May 6, 1977, but still remained at Intercontinental while a turbine prime mover, previously removed, was being re-installed and other changes made.

On page 25 mention was made that a program of upgrading was started that resulted in the original 8,500 horsepower rating being increased to 10,000 horsepower for many of the locomotives. This statement, as such, was incorrect and further explanation should be made of what actually occurred.

The motive power records always indicated that these locomotives were rated at 8,500 horsepower. The turbine prime-mover had a 10,700 horsepower rating, producing 8,500 horsepower input to the generators and 7,000 horsepower at the rail. The 8,500 horsepower rating was arrived at for ambient conditions of 6,000 feet elevation and 90 degrees Fahrenheit. As would be expected, the horsepower output of these locomotives varied considerably at times due to both changes in ambient factors and the locomotive's mechanical condition. In hot, dry weather a turbine with worn buckets and compressor might produce only 6,000 horsepower; while in very cold weather more power was available for propulsion since less was required to compress combustion air.

Several locomotive tests were made with the excitation control at speed set up to pull more than the rated horsepower out of the turbine. The temperature of the turbine exhaust was the first controlling limit until the turbine was powerful enough to go on excitation control. Both of these limits were the "safety valves" so to speak. A good turbine in zero weather might have as much as 13,000 horsepower available before the exhaust temperature control took over at approximately 850 degrees Fahrenheit.

The excitation limits were controls to protect the electrical equipment. If the excitation limits were purposely raised it would have been possible to pull more power out until possibly 12,000 horsepower or more was available. As mentioned, tests were made in which 10,000 horsepower was obtained with the excitation controls set up.

R.E. Prince of the Union Pacific indicated it was "like clamping down the safety valves on a steam engine." This would tend to overload the electrical equipment causing subsequent damage when allowed to continue. Therefore, for all practical purposes, the big turbines were rated as 8,500 horsepower locomotives, with actual horsepower output varying higher or lower due to several possible conditions.

Loco. No.	Turbine Serial Number	Date turbine placed in service	Total fired hours to Oct. 1, 1960	Date turbine opened	Total fired hours when open	Reason turbine opened and remarks.
1	97662	8-31-58	10,218	3-23-59	2,963	Scheduled modifications and evaluation inspection.
				8-16-60	9,547	Scheduled inspection and repair of cracks in transition pieces.
2	97661	9-26-58	6,819 *	2- 5-59	1,800	Failed inlet silencer causing compressor damage.
				4-13-59	2,455	This turbine was removed from the locomotive due to the failure and loss of two second-stage bucket tie pins.
	97670	4-14-59	7,210			The spare turbine, serial # 97670, was installed on 4-14-59 and locomotive was returned to service.
3	97664	10- 2-58	10,000	11- 3-58	437	FIRST TURBINE OPENED. Routine terminal inspection of second-stage buckets revealed tie pins missing and damage to 65 of the 90 second-stage buckets.
				9- 7-59	5,105	Scheduled modifications.
				6-23-60	9,034	Scheduled modifications to combustion chambers and transition pieces.
				8-15-60	9,661	Inspection following a seized rotor indicated that the No. 1 bearing had failed, causing further damage to both thrust bearings.
4	97666	12- 3-58	7,529 *	12-15-58	200	SECOND TURBINE OPENED. Routine terminal inspection revealed broken tie wire in the second-stage buckets. Damage not as severe as to Locomotive 3, serial # 97664.
				2- 5-59	900	Failed inlet silencer causing compressor damage. Opened same day as Locomotive 2, turbine serial # 97661, and for the same reason.

				3-29-59		The air-inlet silencer was found collapsed, evidently due to icing. A new inlet silencer was applied. No damage to compressor could be seen from the turbine inlet, hence the turbine was not opened.
				8- 2-59	3,370	This turbine, # 97666, was removed from Locomotive 4 due to excessive vibration and sent to Schenectady (GE) for analysis and repair. It was later installed in locomotive 9 at Erie (GE) and returned to service in late 1959.
	97661			8- 3-59	(2,455)	The replacement turbine, serial # 97661, had originally been delivered in locomotive 2 and removed for repair on 4-13-59.
				6-22-60	6,359	Turbine was removed from locomotive and sent to the GE area repair shop because of pulsation. Examination showed that some foreign material had gone through the compressor damaging all 16 stages of both rotor and stator blades.
5	97676	1- 8-59	8,560	7- 8-59	7,700	Scheduled modifications.
6	97667	2-28-59	7,815	8- 9-60	7,381	No. 1 combustion chamber casing burned through and damage to adjacent No. 10 casing.
7	97668	3-12-59	7,800			TURBINE OPERATED 3-12-59 to 9-30-60 WITHOUT PROBLEMS.
8	97669	4- 4-59	8,000	8-29-59	2,378	Scheduled modifications.
				1- 2-60	4,300	Severe damage to second-stage buckets as a result of over-heating. Metallurgical examination indicated that blades had been heated to at least 1,700 degrees F. It was theorized that possibly it could have been caused by a partial icing over of the inlet silencer during a long cool-down cranking period when the ambient temperature was near freezing and the relative humidity was high. Such an inlet restriction could produce compressor pulsation, and, along with an abnormally high flow of cold slugs of fuel when starting, produce an over-temperature condition in the second stage.
9	97666	12- 3-58	7,529 *			This turbine was originally in locomotive 4 when delivered. Refer to locomotive 4, date 8-2-59. This turbine operated 4,159 hours in locomotive 9 from 12-1-59 to 9-30-60 without problems.
10	97671	12-19-59	3,675	4-16-60	1,450	Scheduled modification of transition piece holding bars.
11	97672	12-30-59	3,735	4-16-60	1,500	Scheduled modification of transition piece holding bars.
				5-18-60	1,800	Broken turning vanes in new design inlet silencer caused slight compressor damage.
12	97673	2-18-60	3,075	4-16-60	750	Scheduled modification of transition piece holding bars.
13	97674	3-19-60	2,895	4-13-60	300	Routine monthly inspection revealed damage to first stage nozzle and buckets from dowels lost out of transition piece holding bars. This resulted in locomotives 10, 11, 12 and 14 being shopped three days later for modification.
14	97675	4- 9-60	2,386	4-16-60	50	Scheduled modification of transition piece holding bars.
15	127636	5- 7-60	2,175			Turbine operated to 9-30-60 without problems.
16	127637	6-23-60	1,551			Turbine operated to 9-30-60 without problems.
17	127638	7- 7-60	1,300			Turbine operated to 9-30-60 without problems.
18	127639	8-19-60	678			Turbine operated to 9-30-60 without problems.
20	127640	9-13-60	306			Turbine operated to 9-30-60 without problems.
			95,727			

Note that turbine locomotive # 19 was shipped out of sequence and was placed in service in October 1960.

** indicates that this turbine prime mover was installed in more than one locomotive and mileage figure is total mileage through 9-30-60.*

Gordon Glattenberg

During the four months that the gas turbines were used on the South Central District, they were commonly run in multi-unit with the relatively new SD-24's. In this scene the fireman walks back to check the diesels as turbine 25 with a long westbound sits in the siding at Moapa, Nevada, east of Las Vegas, on July 21, 1962.

R. H. Kindig

Even with the building of track three over Sherman Hill, the Union Pacific will run westbounds up the old line as the occasion dictates. Turbine 22 and DD-35 77-B team up on the "CLS" stock train in the late afternoon of September 28, 1968. The 56 car symbol freight is moving 40 miles per hour in this scene east of Granite, Wyoming.

R. H. Kindig

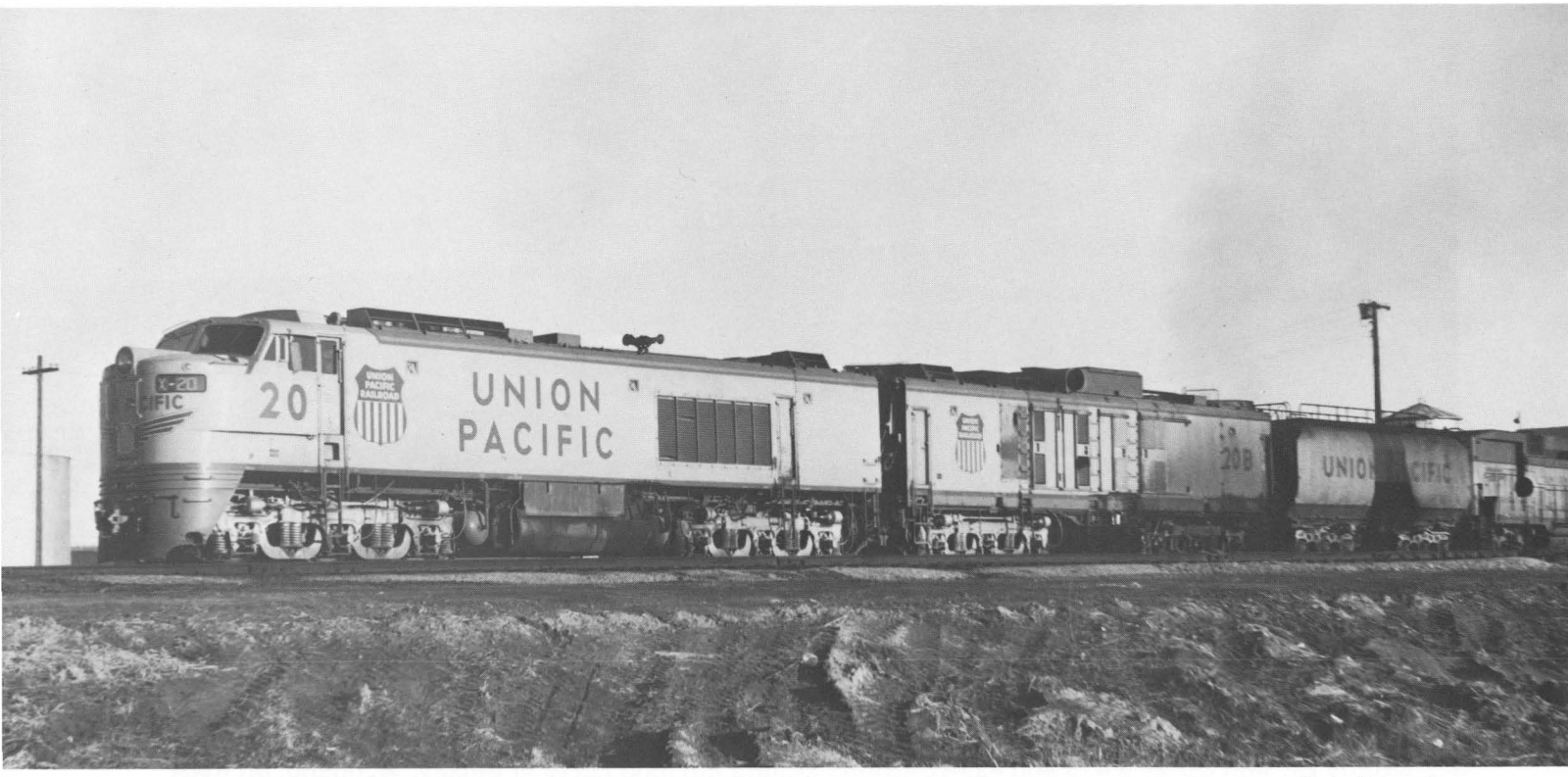
The first of the "super turbines" has left Cheyenne, Wyoming, with an eastbound extra totaling 108 cars and is traveling 25 miles per hour on October 13, 1962, as it makes the run toward Archer Hill.

R. H. Kindig

Gas turbine 29, with SD-24's 419 and 429-B, swings around the long curve at Emkay, Wyoming, on track three over Sherman Hill. The westbound is running 50 miles per hour with its 92 car consist on July 14, 1962, a date when the turbines were being run through to Los Angeles.

R. L. Schmeling

Locomotive #19 had the fourth lowest mileage record of the GTEL-8500 gas turbines and was one of the first to be retired. Pictured at North Platte, Nebraska, on September 13, 1968, the "Big Blow" would be off the roster at year end.



R. L. Schmeling

Locomotive #20 was actually delivered a month before #19 and had a good service record. Mr. Schmeling caught the turbine outside the Council Bluffs, Iowa, shops on a clear, crisp January 2, 1965.

R. H. Kindig

Gas turbine #5, pictured at Cheyenne, Wyoming, June 9, 1962, on an eastbound extra, had a poor service record and was one of the five 8500 HP locomotives never fitted for m.u. service.

R. H. Kindig

Waiting for the blue flags to come down, turbine #9 pauses at Cheyenne on September 16, 1961, before continuing its eastward journey.

R. H. Kindig

Of all 55 gas turbines, #24 had the distinction of running the lowest number of miles and was another of the GTEL-8500 locomotives never converted for m.u. service with diesels. This photo was taken at Cheyenne on September 15, 1962.

GAS TURBINE LOCOMOTIVE FINAL MILEAGE SUMMARY

Loco No.	Total Mileage	Remarks
51	886,302	
52	903,634	
53	854,375	
54	876,711	
55	905,311	
56	854,565	
57	765,706	Lowest mileage 4500 HP carbody locomotive.
58	911,988	
59	939,406	Highest mileage 4500 HP
60	911,299	
61	787,915	
62	769,384	
63	851,860	
64	762,801	Lowest mileage 4500 HP
65	791,340	
66	851,982	
67	828,728	
68	846,342	
69	823,444	
70	784,025	
71	771,078	
72	821,641	
73	797,795	
74	864,515	Highest mileage 4500 HP "Veranda".
75	792,268	
1	882,594	
2	989,619	
3	892,869	
4	1,045,868	
5	832,079	
6	1,117,395	Highest mileage turbine locomotive, all classes.
7	952,421	
8	1,094,412	
9	952,733	
10	982,753	
11	921,693	
12	982,525	
13	931,574	
14	972,509	
15	742,463	
16	972,920	
17	945,327	
18	947,365	
19	818,332	
20	977,527	
21	851,665	
22	985,099	
23	890,385	
24	702,264	Lowest mileage gas turbine locomotive.
25	740,241	Second lowest mileage gas turbine locomotive.
26	1,007,853	Highest mileage locomotive per month in service.
27	866,693	
28	880,654	
29	845,783	
30	828,722	

The author wishes to acknowledge with special thanks the help of Emmett P. McAndrew, Head Clerk at the Union Pacific Equipment Bureau, for his help and dilligent search to provide these mileage figures and much of the other various statistical data found throughout this book.

In reviewing the total mileage figures, it's interesting to note that none of the "Veranda" style turbine locomotives ran 900,000 miles, while five of the ten carbody locomotives topped that figure and eight of the 51-60 class ran more total miles than any of the 61-75 class.

Of the 8,500 horsepower locomotives, 17 ran more than 900,000 miles and four of the "super" turbines topped the million mile mark. Locomotive 6 had the highest mileage, 1,117,395, of all 55 gas turbine locomotives, while locomotive 24, which was stored in the Cheyenne roundhouse for over two years with a burned out turbine, ran the lowest mileage, 702,264, of all the gas turbines.

No doubt many of these turbine locomotives could have run many more miles had the decision been made to retain them in service. The same could be said for the U.P.'s modern super power steam locomotives, such as the "Big Boys", so comparing one to the other with mileage figures proves nothing.

All of the twenty original 4000 class 4-8-8-4's delivered in September 1941 through January 1942, were "million milers" before the steam era ended in July 1959. Locomotive 4006 was the highest mileage "Big Boy" with 1,064,625 miles, while all of the final five, #4020 to 4024 built in November 1944, ran less than 856,000 miles before their fires were dropped for the final time.

Except for the ageless 8444, the steam era ended on the Union Pacific over 18 years ago while the turbine era saw the last run of a "Big Blow" in late 1969. Of the super diesels that the U.P. has also become famous for, only the 6900 class "Centennials" remained in service at the time this supplement was written. The Electro-Motive DD-35 units were stored, many unserviceable. The last of the original 31-53 class U-50's has been retired, and the forty 5000 class U-50-C's have probably run their last miles in revenue service. The retirement of both classes of the GE U-50's marks the close of yet another chapter in the total turbine story for the big 5000 horsepower diesels had been equipped with ex-turbine trucks when originally built.

R. H. Kindig

Gas turbine #15 rests between assignments at Cheyenne, Wyoming, on September 16, 1961. This locomotive ran the third lowest mileage of all 55 gas turbines.

R. H. Kindig

As high noon approached on September 24, 1960, Dick Kindig took a position on the high rocks overlooking Dale, Wyoming, where track three joins the original double track over Sherman Hill. An approaching westbound, a snap of the shutter, and Mr. Kindig had photographed the only doubleheading of two turbines he was to see. The locomotives are the 16 and 3, and the 79 car westbound is moving 30 miles per hour.

R. H. Kindig

Rain clouds drift lazily across the Wyoming sky as turbine 23 slowly moves through the crossover at the east end of the Cheyenne yard with a 90 car westbound extra. June 30, 1962.

Not included in the original book was the story of Union Pacific's participation in a turbine project primarily designed for aircraft usage. The Northrop Corporation began research in 1939 on an aircraft gas turbine power plant, later known as the Turbodyne engine — Air Force XT-37, which was capable of delivering up to 10,000 horsepower. This power plant was intended to drive huge counter-rotating propellers on the B-35 "Flying Wing" and was also later considered for the Boeing B-52 bomber. The rapid advancement in design of jet propulsion caused a shift in Air Force thinking, however, and in 1949 the B-52 design was changed to turbojet, while the B-35 program was entirely discontinued.

One of the principal advantages of the Turbodyne was its ability to use several different kinds of fuel, including diesel oil, kerosene, and gasoline. Other attractive features were its potentially long trouble-free life, and its high power-to-weight ratio. Little wonder that it proved attractive to industries other than aircraft manufacturers.

Officials of Union Pacific were the first to consider application of the Turbodyne as locomotive power. Immediately following company negotiations, the Union Pacific provided Northrop-Hendy with a diesel-electric locomotive chassis in 1947. It was the M-10002, originally a two-unit 2,100 horsepower locomotive used on the original "City of Los Angeles" Steamliner in 1936. The intention was to install a specially designed Turbodyne engine. The bright yellow and red Steamliner unit was a long-familiar sight, parked on a siding at the Hawthorne, California, main plant. But projected high development costs ultimately resulted in termination of the project.

When the Northrop-Hendy partnership was dissolved in 1949, its successor, the Turbodyne Corporation attempted to sell the engine to the Navy as a standby power plant. None of their efforts was productive, and the Turbodyne Corporation was disbanded. At the direction of the Secretary of the Air Force, Northrop turned over the patents, name, and technical data to the General Electric Company, Gas Turbine Division, Schenectady, New York, in 1950. Features of the Turbodyne engine were reported to have been incorporated in General Electric's later gas turbine designs.